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THOMAS NORTON AND THE *ORDINALL OF ALCHIMY*

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THE author of the *Ordinall of Alchimy* was for long taken to be a Thomas Norton of Bristol. For this belief there was the authority of Ashmole, who explained in his *Theatrum Chemicum Britannicum* how the name could be discovered:

> "From the *first word* of this *Proeme*, and the *Initiall letters* of the *six* following *Chapters* . . . we may collect the *Authors* Name and place of Residence: For those *letters*, (together with the *first line* of the seventh *Chapter*) speak thus,
>
> Thomas Norton of Briseto,
> A parfet Master ye maie him trowe"[1].

Michael Maier had observed the same acrostic, for in 1617 he wrote in *Symbola Aureae Mensae*:

> "THOMAS NORTONVS, *Bristoniensis, in arte perfectus magister*, (vt habent initiales syllabae illius libri capitum, quem de hac arte condidit) *agnoscitur*"[2].

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[1] Elias Ashmole, *Theatrum Chemicum Britannicum*, London, 1652, p. 437.

[2] Michael Maier, *Symbola Aureae Mensae duodecim Nationum*, Francofurti, 1617, p. 467.

Concerning this Thomas Norton there are a number of what we may term traditional accounts, of which that in the *Dictionary of National Biography*[3] can be regarded as typical. According to this article, Thomas Norton was a native of Bristol, his father doubtless being the Thomas Norton who was bailiff of Bristol in 1392, sheriff in 1401, and a member of parliament on several occasions during the years 1399 to 1421. The alchemist himself seems to have been returned for the borough in 1436. From the account given by his great-grandson, Samuel Norton, the article continues, Thomas the alchemist was a member of Edward IV's privy chamber, was employed on several embassies, and shared the king's troubles when he fled to Burgundy. Fuller's statement that Norton died in 1477 having financially ruined himself and those of his friends who trusted him, is quoted, but dismissed for lack of evidence; it is suggested that the Thomas Norton who in 1478 accused the Mayor of Bristol of high treason may have been the alchemist.

This article, then, links the alchemist with the important Bristol merchant family of Nortons, and the connection has been usually accepted[4]. However the whole Norton "legend" was challenged by M. Nierenstein and P. F. Chapman in an article in *Isis*, 1932[5]. From their examination of the records of Bristol civic history they made available much interesting information about the Nortons of Bristol, and showed that the author of the *Ordinall* could not have been the member of parliament of 1436, since he was dead by 1449[6], whereas the poem was not begun, according to the last two lines of it, until 1477. They maintain that the evidence of Maier and Ashmole "can scarcely be accepted without criticism"[7], and after examining the records of other Thomas Nortons, members of the well-known family, they conclude that none of these could have written the *Ordinall*, and appear to deny what they call "the Maier-Ashmole hypothesis":

> "There is still, of course, the possibility that some other NORTON, from Bristol or elsewhere, knight, priest, master mason or 'man of

[3] *D.N.B.* XLI, pp. 220–221.

[4] See E. J. Holmyard, "Thomas Norton, an Alchemist of Bristol," *Journal of the Society of Chemical Industry*, XLII (1943), p. 575; John Ferguson, *Bibliotheca Chemica*, Glasgow, 1906, II, p. 145; F. Sherwood Taylor, *The Alchemists*, 1949, p. 132.

[5] "Enquiry into the authorship of the *Ordinall of Alchimy*", *Isis*, No. 53 (XVIII, 2), pp. 290–321.

[6] *Ibid.*, pp. 313–314.

[7] *Ibid.*, p. 294. They say elsewhere (p. 309) that it "may or may not be the case". They do mention the evidence of John Bale who, in 1559, refers to an alchemist, Thomas Norton of Bristol, as having flourished in 1477 and written—among other things—"Alchimiae epitomen, Lib. I Ad honorem Dei in tribus personis." But they cast some doubt on the value of this by pointing out that it comes only at second hand, according to Bale, from Robert Recorde. They do not follow up this point, but go into irrelevant matters concerning Recorde.

> substance', may be found to fulfil the MAIER-ASHMOLE hypothesis, but meanwhile one can say with certainty that MAIER and ASHMOLE were not justified in definitely ascribing the anonymously written *Ordinall* either to THOMAS NORTON . . . or to THOMAS NORTON OF BRISTOLL"[8].

Despite their confident conclusion they have apparently not carried conviction. Sherwood Taylor does not refer to their article in his book[9]; and while E. J. Holmyard agrees in parenthesis that the identification of Thomas Norton is "not reliably" made, his subsequent account of Norton corresponds with the "usually" accepted identification[10]. Though such an attitude does perhaps less than justice to Nierenstein and Chapman's definite discoveries, I believe it sound, because they push their conclusions further than their evidence warrants. The chief points they make against the traditional account are: first, the name Thomas Norton was not known before the seventeenth century; secondly, that Dr. John Dee does not seem to have heard of him; thirdly, that the references by Samuel Norton in *The Key of Alchimie* (1577) to his great-grandfather do not prove anything, because he nowhere mentions the *Ordinall* by name, nor calls his great-grandfather Thomas Norton, and besides this his verse quotations do not correspond with the known text of the *Ordinall*; fourthly, that the only Thomas Norton of the well-known Bristol family who could have written in 1477 was of a violent, almost criminal nature, and clearly could not have been the pious author of our poem.

The purpose of this article is to show that Nierenstein and Chapman's evidence for these points is faulty, and that we have no cause to doubt that the *Ordinall* was in fact written by Thomas Norton of Bristol, member of Edward IV's privy chamber, whom they call Thomas Norton III and whom at least one Bristol historian has correctly identified as the alchemist.

But first a word on the date, which it is important to establish. Nierenstein and Chapman mention the possibility of misdating but, surprisingly enough in view of their scepticism on other matters, accept the traditional date 1477 on the rather slender linguistic evidence supplied them by Dr. Peter Haworth[11]. Dr. Haworth was apparently presented with Ashmole's text of 1652, and although he was right in his opinion that the original was 15th century, he had

[8] *Ibid.*, pp. 320–21.

[9] *The Alchemists*, p. 132.

[10] *Alchemy*, Penguin Books, London, 1957, p. 186.

[11] *Isis, op. cit.*, p. 298–299. The Chaucerian final *-e* was not pronounced as late as 1477, as Dr. Haworth implies; (see e.g. Fernand Mossé, *Handbook of Middle English*, trans. James A. Walker, Baltimore, 1952. Section 36). On the other hand the Midland present plural ending *-n* remained into the early sixteenth century (see H. C. K. Wyld, *History of Modern Colloquial English*, 3rd edition, 1936, p. 338). The irregularity of versification in the *Ordinall* makes conclusions on metrical grounds very dubious.

not the basis for rigorous proof. Nierenstein and Chapman add that his conclusion is borne out by the list of authors and works mentioned in the *Ordinall*; they make a complete list, but do not show in detail which of the names of authors or works are relevant to the dating of the poem[12].

Since the doubt has been raised and not satisfactorily resolved, it will now be settled. The existence of two early manuscripts makes it clear that the poem was written in the 15th century. One of these, probably the earlier, British Museum Additional MS. 10302, is described in the catalogues as 15th century. It is on vellum, and contains the well-known illustrations, apparently very similar to those which were adopted by Ashmole[13]. The second is Bodleian MS. E.Mus. 63, which is described in the *Summary Catalogue* as "early 16th century"[14]. D. W. Singer, however, includes it in her catalogue of alchemical manuscripts[15], and in *The Middle English Dictionary* now being published at the University of Michigan, this MS is cited for both the *Ordinall* and Ripley's *Compende of Alkemie* as "? *c.* 1500"[16].

For the earlier date, the *terminus a quo* for the composition of the poem, there are three obvious pieces of internal evidence. Gilbert Kymer, Chancellor of Oxford and physician to Duke Humphrey, is spoken of in the past tense as if he were dead[17]. He died in May 1463. There is also reference to "the change of the coin" of 1465[18], and to the Battle of Tewkesbury, 1471[19]. But in addition to these, the references to Thomas Herbert[20] and Brise[21] bring us even nearer to 1477.

Thomas Herbert, who was responsible for the mistreatment of the alchemist Daulton, was presumably the brother of William Herbert, first Earl of Pembroke, who was executed at Northampton after being captured at the Battle of

[12] *Isis*, *op. cit.*, pp. 299–302.

[13] It is possible that the fair-haired man of rather distinctive features who appears in three of the illustrations may actually represent the author. (See John Read, *Prelude to Chemistry*, Plate 34, for a reproduction). This MS is probably a presentation copy, like the "*Henry the seaventh's* owne *Booke*" mentioned by Ashmole, *Theatrum Chemicum*, p. 455. It is very legible, but unfortunately lacks Chapters VI and VII, and 120 lines of Chapter V.

[14] F. Madan, H. H. E. Craster and N. Denholm-Young, *A Summary Catalogue of Western Manuscripts in the Bodleian Library at Oxford*, Vol. II, Part II, 1937, pp. 719–20.

[15] Dorothea Waley Singer, *Catalogue of Latin and Vernacular Alchemical Manuscripts in Great Britain and Ireland dating from before the XVI Century*, Brussels, 1928–31. II, p. 557.

[16] Hans Kurath and Sherman M. Kuhn, edd., *Middle English Dictionary, Plan and Bibliography*, Ann Arbor, Michigan, 1954, p. 62.

[17] Ashmole, *Theatrum Chemicum Britannicum*, p. 57.

[18] *Ibid.*, p. 52.

[19] *Ibid.*, p. 38.

[20] *Ibid.*, p. 35 ff.

[21] *Ibid.*, p. 52.

Edgecote in 1469. On the day of the battle, the Earl wrote his will addressed to his wife and his brother Thomas Herbert, apparently making them executors[22]. Not much more information about Thomas is traceable, but a record exists that the manor of Duntesbourn Rous in Gloucestershire was granted to him and his male heirs in 2 and 5 Edward IV (1462 and 1465). The same manor was granted to Sir Richard Beauchamp in 1474, after Herbert's death without male heirs[23]. He must have died, then, in 1474 or slightly earlier; and since our author knew he was dead, at least the passage referring to him must be of later date.

A date even nearer to that given by the author, 1477, may be reached with some conjecture. The "Brise" whose name begins Chapter V was a London goldsmith, Hugh Brice[24]. He was appointed clerk of the mint in the Tower of London, 2 February, 1466. From instructions issued to him on 6 March, 1469, it appears that he was deputy to the master, Lord Hastings. The coinage was to be altered and all gold and silver coins were being called in, Brice's duty being then to give fixed sums in exchange for the gold nobles coming in, according to their size and weight. Since Edward IV in 1465 had arranged for a new coin to be issued, the Ryal or Rose-Noble, worth 10s. but containing only as much gold as Edward III's Noble of 1351, worth 6s. 8d., it is not surprising that he "made some men sorry"[25]. No doubt his activities at the mint made the biggest impact on his contemporaries, as the casual reference in the *Ordinall* implies; but for posterity he is Hugh Brice, "Citezeyn and Alderman of London", who paid for the printing of Caxton's *Mirrour of the World* (1480) to be presented to Lord Hastings. He was in the public eye nearer to 1477, however, being Sheriff of Middlesex in 1475 and of London in 1475–6. It seems a plausible conjecture that this recent prominence brought his name before the mind of the writer of the *Ordinall*.

In any case the poem must have been completed between 1474, when Herbert was dead, and 1500. There is no reason to doubt the author's statement that he began his work in 1477, and no evidence that anything in Ashmole's text (or in any of the manuscripts I have seen) was added at a later date. Nierenstein and Chapman think that a passage mentioning Boethius was added later[26], but the Boethius referred to wrote in the early 6th century, not the 17th, and the quotation, "tu numeris elementa ligas", is from *The Consolation of Philosophy*[27]. They are therefore quite right to reject the member of

[22] William Dugdale, *Baronage of England*, London, 1675. II, p. 257.

[23] Samuel Rudder, *A New History of Gloucestershire*, Cirencester. 1779, p. 424.

[24] See *Calendar of the Patent Rolls*, E.4, p. 475; E.4–H.6. pp. 149, 546, 551, 556, 586.

[25] Charles Oman, *The Coinage of England*, Oxford, 1931, pp. 175, 199, 219–21.

[26] *Isis, op. cit.*, p. 301, f.n. 50. They refer to an Anselmus Boetius who wrote on gems and precious stones in 1609.

[27] Boethius III, Metra ix, 10 (Loeb Classical Library, 1918, p. 264). Ashmole, *op. cit.*, p. 60.

parliament for Bristol of 1436, whom they call Thomas Norton II, as the author, for he died, as they show, in 1449. However there remain two other Thomas Nortons of the family, his nephews, in the 15th century, and we must examine their reasons for rejecting them.

In the first place there seems no point in doubting the "acrostic" described by Maier and Ashmole. It is hardly likely to be accidental and some of the opening lines of chapters seem to indicate that the writing was strained to accommodate it. Tonsile of Chapter III, and Brise of Chapter V are introduced rather clumsily, while "*Normandy* nurished a *Monke* . . ." at the beginning of Chapter II is not a natural form of expression[28]. Nor apparently was Maier the first person to note the "acrostic".

Longleat MS. 178 contains several alchemical and other works copied out by Francis Thynne, and these include the *Ordinall*, completed, as Thynne noted at the end, on 3 June, 1574[29]. At the beginning, squeezed into the left hand margin, is a note:

> " his name was thomas Norton of Bristowe as apperethe by the addinge together of the first syllable of euery chapter & one of ye preface for the first preface begynnethe wth To: the 1 chap wth mas. the 2 wth Nor the 3 wth Ton: the 4. wth of the 5: wth Bris. the 6 wth Towe. & so thomas norton of Bristowe"[30].

This note is not in the hand in which Thynne copied out the *Ordinall*, but could well be by him. It is in a less cursive hand, like that in which he copied Ripley's *Compende* in 1578[31], and very similar to that of his autograph letter to his uncle Sir John Thynne, dated 20 February, 1575[32]. I think it safe to assume that it is by Thynne, especially as there is no other evidence in the manuscript that anyone added anything to his collection. Moreover it fits with Thynne's known antiquarian knowledge. If our assumption is correct, it antedates Maier by eight years at least, since Thynne died in 1608.

Nierenstein and Chapman's assumption that Norton's name was not known in the 16th century is surprising. Ascham mentions "Th. Norton of Bristow" as a poet in such excellent company as Chaucer, Surrey and Wyatt[33], and Waltee Haddon's *Poemata* (1567) contains a poem of eight lines "In librum Alchymiar Thomae Nortoni Bristolensis"[34]. They may not have known him as the

[28] In Chapter VI, however, "*Towards* the Matters of Concordance" illustrates a natural, though obsolete use of the preposition, meaning "with regard to".

[29] f. 49a.

[30] f. 10b.

[31] ff. 58a–86a. The date of completion, 5 April, 1578, is on f.86a.

[32] In Vol. XL of the *Thynne Papers* at Longleat House. This letter was kindly brought to my attention by the librarian, Miss Dorothy Coates.

[33] Roger Ascham, *The Scholemaster*, London, 1570, p. 60.

[34] On page 82.

author of the *Ordinall*, but Bale gives the first line of the "Epitomen Alchymiae" by Thomas Norton of Bristol as "Ad honorem Dei in tribus personis", clearly a translation of the first line of the *Ordinall*[35]. In view, however, of their statement that "his name only became known in the 17th century"[36]. it seems useful to list references to him in some 16th century manuscripts of the *Ordinall*. For his name, Norton or Thomas Norton, I have noted the following:

1. Bod. MS. Ashmole 1490, Item 83, ending: ". . . 'Explicite, and nowe laste copied out bi me Simon Forman, 1591. March the 23' etc. . . . The English Preface follows, headed 'Norton 1477', . . . and subscribed with a like colophon by Forman"[37].
2. B.M. MS. Sloane 3580 B. f. 117a.: "This ordynall of Allchymy, was firste made & compiled by Thomas norton, as I haue lerned synce I copyed yt oute 1580."
3. Longleat MS. 178. f. 10b. "This booke followinge is called the ordinall of Alchymie made by mr nortone of Bristowe, he florished in the yere of our lorde 1477 and was the scoller of Rypleye"[38]. Other references to Norton occur at ff. 12b, 25a, 28a, 49a.
4. Bod. MS. 7643, f. 300: "Thus endyth ye Ordynall of Mr NORTON, made by hym in ano 1477. Coppyed by Rychard Waultowne alias Walton, the 20 of October ano 1565. . . ."
5. B.M. MS. Royal, 18B XXIV. f. 79a: "Thomas norton of Alchymy." This is the heading at the beginning of the *Ordinall*, Item 3 of this MS. According to the *Catalogue of the Royal Manuscripts*, Items 2 and 3 are on similar paper and in the same hand. Item 2 is Ascham's *The Scholemaster*, the first book only. This was begun in December 1563, "but the MS. text includes references (e.g. at f. 73, to the Lord Mayor, Sir Thomas Lodge, "even this last yere", viz. 1561–2) which agree with the date named, and this accords roughly with the water-mark of the paper"[39]. Item 3 includes Haddon's lines on Norton, but that does not mean that the copy of the *Ordinall* is post–1567.
6. B.M. MS. Sloane 1198. Two marginal mentions of "norton" occur, ff. 12a, 12b. The hand of this version is not unlike that of the next, and seems to be of the first rather than the second half of the 16th century[40].

[35] John Bale, *Scriptorum Illustrium majoris Britanniae . . . Catalogus*, 1559. II, p. 67.

[36] *Isis, op. cit.*, p. 290.

[37] W. H. Black, *Catalogue of the Ashmolean Manuscripts*, Oxford, 1845, col. 1365.

[38] This is the heading of the poem, in the same hand and ink as the text, 1574.

[39] George Warner and Julius P. Gilson, *Catalogue of the Western Manuscripts in the Old Royal and King's Collections*, 4 Vol., 1921, II, p. 297.

[40] This MS. is not among the nineteen given in Carleton Brown and R. H. Robbins, *The Index of Middle English Verse*, New York, 1943, p. 604. Seven other Sloane MSS. also do not appear, together with Bod. Ashmole 57, Dublin, Trinity College 684 and Edinburgh, University Library, Laing III 164. Of the Sloane MSS., 2174 contains two copies, the second (ff. 117–139b) incomplete and not recognized in the catalogue as the *Ordinall*; it is evidently early 16th century.

7. Bod. MS. E Mus. 63, f. 2a. The title "Liber T.N. qui intitulatur Ordinale Secretorum", is in the same hand as the Latin of the preface and in the text, and the same ink as the whole of the text. This is one of the two early MSS. mentioned above, so that the author's initials at least were known early, perhaps within his lifetime.

For the place, Bristol, I have the following references:

1. B.M. MS. Royal 18 B XXIV, f. 103b: A description of one of the illustrations which the writer says occurred: "In nortons owne bok fownd in bristowe. . . ." The same accounts of illustrations are in MSS. Ashmole 57 and Longleat 178, each referring to "Norton's own book found in Bristow".
2. Bod. MS. E Mus. 63, f. 4a: in the space left at the end of the Proem is written in Welsh, Latin and Greek:
   "dialogus TN e iG peri τHς ιερας Murias
   ple y trig di gorff εn τω Brysto
   A ddylphyd dim i ffwrdd ouk i mae
   yn Barod yn ddwyn die g februarii 20 1578 τω θεω δοξα."

We may attempt a rough translation of this obscure passage as follows:

Dialogue of TN and iG (John Gwynn)[41] around St. Mary's.
Where is your body? In Bristol.
Has anything been taken away? (Unintelligible).
It is ready to be taken away, Wednesday, the 20th day of February, 1578. Glory to God.[42]

The exact significance is not clear, but possibly it represents a necromantic conversation between John Gwynn and Thomas Norton's ghost in the churchyard (peri) St. Mary Redcliffe in Bristol, or perhaps the conversation was about the church. That the Norton family were not buried there might have provoked the first question. If this is too fanciful, it is none the less clear that someone, presumably Gwynn, in 1578 associated T.N. with Bristol[43]. We can say then that a number of people interested in alchemy knew the name of the author of the *Ordinall* in the 16th century, and some knew his place of residence.

We could therefore be reasonably sure *a priori* that Dr. John Dee knew of Thomas Norton and the *Ordinall*. If we may trust Ashmole's note at the beginning of MS Ashmole 57, this extremely neat, legible copy is in Dee's own hand; and it contains the reference mentioned above to "Nortones owne booke

[41] He owned the MS in June 1569, and at least as late as 1582. (See *Summary Catalogue*, II, ii, p. 720.) He is probably the same "John Gwyn" to whom Dr. John Dee sent a letter in 1597 (see J. O. Halliwell, ed., *The Private Diary of Dr. John Dee*, Camden Society, 1842, p. 57).

[42] I owe the translation of the Welsh to the kindness of Mr. Geraint Gruffydd in the Bodleian Library, 1952, and the suggestion that "Murias" was "Mary's" (Myriam) to the Byzantine historian, Rev. F. Dvornik.

[43] The N of "TN" in this passage is badly formed and might be taken for H. But where the same form of initials occurs on f. 62a, followed by a quotation from the *Ordinall*, there is no doubt that N is intended.

found in Bristowe", and also "At the beginninge of the Fifte Chapter was the Image of Norton . . ."[44]. Nierenstein and Chapman doubt Ashmole's word here, pointing out that there is no mention of the *Ordinall* in Dee's catalogue of his library of 1583[45]. But if he did not own a copy in 1583, he did in 1595 when he signed his name on f. 41 of Bodleian MS. E Mus. 63. He seems to have owned another copy as well, since where this MS reads, referring to Herbert's maltreatment of Daulton:

> "ffro thence he had hime to prysone fast
> to Twitill foure yeares were nere past"

someone has written in the margin "Dee liber habet Troy troia" which is the correct reading:

> "to Troy till foure yeares were nere past".[46]

Further proof that Dee knew of Norton appears on f. 3b of B.M. MS. Sloane 2327, where there is the story (quoted by Thorndike) of the monk who laboured twelve years at alchemy with no result, whereupon in despair he wrote a book of "Receipts" called *Flos Paradisi* by which he misled others and brought them too to desperation[47]. Dee owned this manuscript, and wrote at the side: "Norton speaketh of such a monk". He is clearly thinking of the monk who wrote a book of a thousand receipts, and who is mentioned in the Proem to the *Ordinall*.[48]

Having demonstrated the earliness of the belief that the *Ordinall* was by Thomas Norton of Bristol we come to the chief piece of evidence used to identify him. This is the implied claim of Samuel Norton in 1577 that his great-grandfather wrote the work. Samuel Norton's work, *The Key of Alchimie* is found in Bod. MS. Ashmole 1421, but my citations are taken from a transcript made in the mid-19th century by William Alexander Ayton, and now in the library of the Wellcome Museum in London. Nierenstein and Chapman[49] quote the important passage from this work, but I propose to repeat and extend the quotation here. In his "Preamble", addressed to Queen Elizabeth, Samuel

[44] Pages 52 and 60. The latter page gives the description of the alchemist with the balance in a glass case.

[45] *Isis, op. cit.*, p. 290, f.n. 1. The absence of the *Ordinall* from Dee's catalogue should not be seriously regarded. The number of MSS. marked "anglice" is small, and a notable absentee is Ripley's *Compende of Alkemie*.

[46] f. 14a; *cf.* Ashmole's *Theatrum*, p. 37. Troy House is about a mile from Monmouth; it was formerly the seat of the Herberts, and contains some Herbert family portraits. (J. H. F. Brabner, *Comprehensive Gazetteer of England and Wales*, 5 Vols., London, 1894, IV, p. 286).

[47] Lynn Thorndike, *History of Magic and Experimental Science*, III, pp. 74–5 and f.n. Thorndike quotes from a *De Secretis Naturae* attributed to Arnald of Villanova.

[48] Ashmole, *op. cit.*, p. 8.

[49] *Isis, op. cit.*, p. 315.

says that in the time of Edward IV seven men possessed the art of alchemy, four religious and three laymen.

> "Dalton, monk of Tewkesburie was one; My great-grandfather's Master, another, The third our Noble George Riplie Chanon: The 4th Wharram (?), Bishop of Yorke to whom Riplie wrote his Medulla; The laymen which were favoured of the king, One of them was a stranger Borne in Loraine, the other nigh the middest of England, the 3d of them was my great grandfather himself, being of the privie chamber, divers times an ambassador for him, & one also that with himself bore such fortunes frownes (as the treacherous Earle then drove the king unto when he was forced to flie into Burgonie:) Of whom I not a little wonder why he would not impart it to the king; & yet in his book I find that hee was willing thereto; yf some great fault in the king had not letted it; for in his book after a mourning sort he saith;
>
> Truly king Edward was nigh therto
> If sinne had not kept him therefro
> But surelie sinne jointlie with grace
> Will not be together in one place.
>
> ffor further he addeth
>
> Gratia tardatur peccatum dum dominatur,
>
> That is to say
>
> Grace of consolatione
> Is deferred while sinne hath domination.
>
> Yet both in the beginning & ending of his book hee after a prophetical kind of manner giveth out that that science shall happen to the kings of England, where his words are found to be on this wise
>
> Yet once this science I understand
> Shall greatly honor the throne of England
> When in this Land shall raigne a king,
> Which shall love god above althing
>
> The Lateine verses in the beginning of his book are to many & to long to be recited, but that which I most of all desire to come to pass, is that which hee intimates in his 6th Chapter where speaking of the stone to be revealed to the kings of this Land, it shall be found hee saith
>
> By the fortune & by the grace
> Of a woman faire of face
>
> And what know I Oh Queene! whether it be yr. selfe or noe? I write not this unto yr. Matie that I mean hereby to present myself as able to perform it, although I hope it may be by yr. Matie licensed from danger of the Law . . .".

Nierenstein and Chapman[50] point out that Samuel Norton makes no definite reference by name either to the *Ordinall* or to his great-grandfather as Thomas Norton; nor does he reproduce the exact words of the *Ordinall.* Moreover, they

[50] *Isis, op. cit.*, pp. 315–16.

add, there is nothing about the Kings of England at the end of the book, or in Chapter VI. All this is quite true, and furthermore the passage mentioning King Edward by name—although the past tense "was" is not conclusive—is unlikely to have been written in 1477 while he was still alive. Of course Samuel could have been referring to any of his four great-grandfathers, but let us note that we know of one of them, Thomas Norton of Bristol, that he was "of the king's household", and so fits the description, "of the privie chamber"[51]. Now Nierenstein and Chapman agree that the passage has "a definite atmosphere suggestive of the *Ordinall*. There is a certain similarity about some of the ideas which gives colour to a theory that SAMUEL NORTON may be rendering some of the passages in a very free translation". I would go further and say that the stylistic resemblances to the *Ordinall* are so close that it is hard to believe that Samuel is not referring to and quoting from it, and it is clear that earlier writers made the assumption unhesitatingly. Much more likely than a "free translation" theory is that Samuel knew of a version that had been revised in parts, with the Proem numbered Chapter I, and Chapters I–VII renumbered II–VIII respectively. That he knew of such a version is proved by three quotations from *The Key of Alchimie* which Nierenstein and Chapman do not seem to have read.

1. When dealing with the ignorance of workers who misunderstand their texts he says[52]:

> "And farre further they avouch divers Authorities, as among others Tho: Nortons authoritie for one; where in his 4th Chapter hee saith, yee may not with metalls & quicksilver beginne, To make Elixirs w^{ch} yee intend to winne; Small clarkship there is therein, for they are not for this art, These words are not amiss if they were rightly weighed. . . . And in that behalfe are Thomas Norton his words w^{ch} in a little after where hee not after his accustomed manner of most dark speech uttereth his meaning very plainly as appeareth in these words:—
>
> Yet if you destroy their whole composition
> Some of the component parts serve y^{r} conclusion
> And that is nothing else of that one or yt other
> But only magnesia & Litharge her brother.
>
> By w^{ch} words is given to understand . . .".

Here we have two quotations attributed to Thomas Norton, one of some three and a half lines, the other of four lines. The second passage corresponds fairly well with the end of Chapter III of Ashmole's text of the *Ordinall*; the principal differences are Ashmole's "Compounds" and "*Magnetia*" for Samuel Norton's "component parts" and "magnesia". The first two lines of the first passage

[51] For the significance of this see below (p. 82).

[52] Pages 228–29 of the Wellcome Museum transcript.

are also recognisable variants of the two lines in Ashmole immediately preceding[53]. Yet the latter part of the first passage corresponds to nothing either in Ashmole's text or in those of the two early manuscripts mentioned above. Moreover, Samuel says that these passages are from the fourth chapter. The second of our three quotations from *The Key of Alchimie* is as follows[54]:

2. ". . . Of w^ch^ Thomas Norton (though enigmatically enough) maketh mention in his sixth chapter, where he speaketh of such liquors as apt the stone hath these words—

> Other men say no liquor from above
> Descended better than such as cungers love".

Again this is from Chapter V of the *Ordinall*, not Chapter VI, and the quotation is inexact. Ashmole's text reads:

> "Another sort said no Liquor was above
> The Liquor which Congers most desier and love"[55].

In the third quotation the case is plainer still[56]:

3. ". . . Although of later yeeres there were some whose memories are fresh, as about an hundred yeeres since were Thomas Norton, whose owne words are these

> I made also the Elixir of Life
> W^ch^ mee bereft a marchant's wife:
> She wrought with it a full great wonder;
> I made the quintessence w^ch^ set under
> The nose of him w^ch^ soundeth nie to death
> Would make revive thereof the only breath.

Y^f^ of him it were asked what daies he lived; there were some lately that could well report, for he lived since the birth of my father & was provectae aetatis".

[53] Ashmole's text on p. 43 of his *Theatrum*, is as follows:

> "Ye may not with mettals or Quicksilver beginn,
> To make *Elixir* if you intend to winn:
> Yet if you destroy the whole Composition,
> Some of their Compounds will help in Conclusion;
> And that is nothing Els of that one or that other,
> But only *Magnetia* and *Litharge* her Brother."

In the fourth and sixth line, Bod. MS.E Mus.63 supports Samuel Norton's version, reading "componentes" and "magnesia".

[54] Page 239 of the Wellcome Museum transcript.

[55] The two early MSS support the sense of Ashmole's text (*cf.*, p. 78, *op. cit.*) though they omit "sort."

[56] Page 297 of the Wellcome Museum transcript.

This is clearly an expansion of the passage as we know it from Ashmole, and the early manuscripts. Ashmole's text reads:

> "I made also the *Elixer* of life,
> Which me bereft a Merchaunt's wife:
> The *Quintessens* I made also,
> With other secrets manie moe,
> Which sinfull people tooke me fro"[57].

From these three quotations we can see that Samuel Norton knew of a version in which our present Chapters III and V were called IV and VI respectively, and which had been in parts altered and expanded from the earliest manuscripts and Ashmole[58]. This version he attributes to Thomas Norton, and implies that it was fairly well known since some workers use it as an authority though they misunderstand it through ignorance. He does not say that this Thomas Norton was his great-grandfather, but it would be carrying scepticism rather far not to accept the identification.

The Nortons were not an unknown family; Samuel's father was a knight, and they would be known by many to have had an ancestor, Thomas, a fairly prominent man in the time of Edward IV. If Samuel Norton quotes from a well-known alchemical poem by a Thomas Norton not his great-grandfather, and also from an alchemical poem very similar to it in style and ideas by one of his great-grandfathers not Thomas Norton, we might well feel that he owes us an explanation. He is attempting to gain royal favour in his "Preamble", and appears to be somewhat on the defensive; is it likely that he would prejudice any good will towards himself by appearing to imply what could be disproved? Besides, if Thomas Norton's *Ordinall* is an authoritative source, then of the three laymen who possessed the art in Edward IV's time which is he if not Samuel's great-grandfather? Why, since Samuel knew his name to quote in his work, did he not give that name to one of the two anonymous alchemists, either to him of Lorraine or to him of the middle of England? The answer must be that the two were one, and that Samuel refers to him as his great-grandfather in the "Preamble", but more formally in the body of the work as Thomas Norton, though in the last citation, where personal reminiscence comes in, he becomes less formal and says that he was alive "since the birth of my father"[59].

[57] *Cf.* Ashmole, pp. 34–35.

[58] It would be interesting to know if such variants occur in any extant MS. I have not found them in the Bodleian or B.M. MSS, nor does Ashmole seem to have known them, for the variants he wrote into his own annotated interleaved copy of *Theatrum Chemicum* (Bod. MSS, Ashmole 971, 972) do not include them.

[59] It is possible that Samuel Norton may have been secretly ashamed of his great-grandfather's unsavoury reputation.

Acceptance of a theory of a revised *Ordinall* clears up the difficulties of the "Preamble". The Latin line: "Gratia tardatur peccatum dum dominatur" may be taken as a revision of line 28 of the Latin Preface: "Propter peccata tardantur *munera grata*". The reference to "his 6th Chapter where speaking of the stone to be revealed to the kings of this Land . . ." falls into place as corresponding to the passage in what we know as Chapter V:

> "When that beginneth note well this thinge,
> This *Science* shall drawe towards the *Kinge*;
> And many moe Graces ye maie be boulde,
> Moe then of us shall now be tould;
> Grace on that *King* shall descend,
> When he ould Manners shall amende . . ."[60].

To this same section of the *Ordinall* may be referred the passage on Edward IV, added after his death, while the other quotation referring again to the kings of England—"Yet once this science I understand, Shall greatly honor the throne of England"—could very well come at the beginning or ending of the book, since it is a free rendering in the metre of the poem of lines 29–30 of the Latin Preface:

> "Saepe Reges Angliae decorasset haec res,
> Firma si in domino fuisset eorum spes"[61].

Probably Samuel's rendering of "Gratia tardatur" is from the same free rendering, two lines of English to one of Latin. The existence of a copy owned by Henry VII[62], and B.M. MS. Ad. 10302 which seems like a presentation copy, lends colour to the suggestion that Norton perhaps revised a little for each new patron to whom he presented his work, and perhaps the hope of interesting an important patroness led to the lines, quoted by Samuel, about "a woman faire of face." This must have seemed a happy chance to the writer's great-grandson when he came to address Queen Elizabeth.

The evidence, then, points strongly towards the author as being Thomas Norton, great-grandfather of Samuel Norton, nephew of the Thomas Norton II who died in 1449, the son of the latter's brother, Walter Norton. It is in fact this Thomas Norton who is picked out by F.A. Crisp as the alchemist. In his *Abstracts of Somersetshire Wills*, he gives his will, and selects him from the other Thomas Nortons for a footnote: "The most skilfull alchemist of his time", quoting from *Bristol Past and Present*[63]. He had a younger brother, also Thomas, but, as Nierenstein and Chapman show, he was dead before 1479, and even if old enough to write the original *Ordinall* in 1477—as is unlikely—he was

[60] *Cf.* Ashmole, *op. cit.*, p. 53.

[61] *Ibid.*, p. 4.

[62] Mentioned by Ashmole, p. 455.

[63] F. A. Crisp, *Abstracts of Somersetshire Wills*, 5th Series, 1890, p. 73.

not alive to make any revisions. The elder brother, whom they call Thomas Norton III, is rejected as a possible author by Nierenstein and Chapman solely on grounds of character, and to this point we must now turn.

Walter Norton, the father of the two Thomases, in 1458 by a feoffment assigned all his real property in Worcestershire and Bristol to his two sons-in-law, directing them to re-convey the estate, except half of the Great House, to his younger son, "that he schold not be vexid ne troublyd by Thomas, his Eldyr Brother"[64]. There was a strange delay in executing the deeds, and finally in 1466 Walter brought the documents to the Council House and requested their enrollment, according to the custom of the city, to assure their validity. He further requested the Mayor, Sheriff, and other dignitaries to accompany him to St. Peter's Churchyard, so that he might in their presence give possession of the eastern half of his house to his younger son Thomas, in the name of all the estate[65]. He had already given up all his jewels and household possessions to his younger son, and made him "sieur thereoff in hys lyfe"; while in his will[66], dated only six days before, he had left to the elder Thomas only a silver cup, some hangings and cushions in the hall of his dwelling, and "the standing bed in the great chamber with its tester and curtains;" the elder Thomas was also to have the western half of the Great House. The obvious inference would seem to be that Walter distrusted his eldest son, and wished to make certain that he laid no hand on his property after his death. Yet only ten months later Thomas Norton the younger was appearing before the mayor and sheriff to complain that his father, "by the synystre labour and informacion of yll-disposid persoones hathe publisshed and noysed in dyversez Countreys that he hath enfeoffid the seyd Thomas Norton the Younger his son but of trust onely to his owne usze", and that he intended to make void the existing deeds and disinherit the complainant, "against all right and conscience". At his request the civic officials solemnly affirmed that they were witnesses to the transfer of the property[67]. What further action, if any, Walter took is not known. From the incident one may see simply evidence of wildness and cupidity in the elder Thomas, but since the father had a difference with the younger son and proposed to disinherit him as well, the fault may have lain with the father.

But the *Great Red Book* contains another document[68] which throws light

[64] *The Great Red Book of Bristol*, Text (Part III), Bristol Record Society's Publications, XVI, p. 145.

[65] *Ibid.*, pp. 139–42.

[66] *Ibid.*, p. 112.

[67] *Ibid.*, pp. 139–42.

[68] Nierenstein and Chapman draw for their account on J. Latimer, "Some Curious Incidents in Bristol History," *Trans. Bristol and Glouc. Arch. Society*, XXII (1899), pp. 275–83. But the original document has been published in *Bristol Record Society Publications*, XVIII, pp. 57–93, and the quotations given here are taken from it.

especially on the elder Thomas, and it is this which chiefly influenced Nierenstein and Chapman. This is a "Remembraunce Nevir to be put in oblyvion but to be hadde in perpetuell memory of all the trewe Burgeises and lovers of the Towne of Bristowe of the Innatural demeanyng and the Inordinate behavyng of Thomas Norton of Bristowe Gentleman against the noble famouse and trewe merchaunte William Spencer beinge the thirde tyme Maire of the Towne of Bristowe", and it was compiled by John Twynyho, the recorder, who advised the Mayor in the matter. On Friday, 12 March, 1479, Thomas Norton came to the Mayor, and read him an accusation of high treason, protesting that this was not because of any dispute depending between him and the Mayor but only in "subduyng of the Renued malice and traytrous dispositioun Surgyng of thyne olde Rotyn hatefull and Traytrous hert". The usual formal offer of trial by combat was given, and Norton gave his glove and sealed appeal to the Sheriff, who was present. The next day the mayor, apparently to the great distress of the council, announced that he would not remain in office until he was cleared of the charge, and gave himself up to the sheriff to be taken to the gaol until the king heard of the case.

On the Sunday the sheriff delivered the appeal and glove to Thomas Asshe, yeoman of the King's Chamber, and Comptroller of the Port, to be given to the king, with a letter from the sheriff stating that Norton had retained divers riotous and idle persons by oath and otherwise, and that the previous week the mayor had ordered five of them to be arrested for assaulting the bailiff of Temple fee and leaving him for dead; three were arrested, two escaped. On Monday the sheriff, bailiffs, and the rest of the council sent a full account of Norton's conduct to the King and the Privy Council. The letter speaks highly of Spencer's good deeds and then launches into the denunciation of Norton quoted by Nierenstein and Chapman[69]. He haunts taverns, keeps in his service "many idell and misgouvernid persones", neglects divine service and on Sunday afternoons plays "at the Tenyse and othir suche fryvolous disportes". He has troubled his father and mother and "sith theire decees he hath interuptid and broken theire last willes and testaments". He has imprisoned his younger brother and acquired his property by forcing his father-in-law, John Shipward, to give him the deeds to it, abusing his authority as king's agent by threatening, or at least by falsely letting it be known he had authority, to behead him if he refused. He had finally driven his younger brother to fly to Spain, and during the voyage there his brother was drowned. He had agreed to pay a rent to his younger brother's widow, but had withdrawn from the agreement.

When Norton arrived in London to appear before the king, the deputies of the town had preceded him, and "The kinge estraunged his loke from him And he perceivid that and departid from the Courte to Braynesforde And all the

[69] *Cf.* Nierenstein and Chapman, *Isis*, *op. cit.*, p. 318.

Courte hath him in suche lothnes that no Creature accompanyed nor made him anny chere". When finally on Saturday 20 March the case was heard, Norton had no evidence to put forward; as the "Remembrance" puts it: "almighty god that is the serchere of all hertes and Knowith the previtee of all sacresies made him so fele and understande his oune untrue demeanyng in this matier that he coude unnethe (hardly) loke speke ne Kepe his countenaunce before the Kinge and his Counceile but demenyd himself as a persone Ronne into fronsy". As a result the case against Spencer was dismissed. According to Adam's *Chronicle of Bristol*, the mayor was "highly commended of the King for his wisdom; and the said Norton was severely checked of his malicious intent"[70].

The character given Thomas Norton by the Bristol council and his behaviour in this incident, an attempted revenge upon the mayor for restraining his riotous followers, "are scarcely recommendation for the authorship of the *Ordinall*"[71]. Perhaps not; but it is also true that all this evidence comes from one source—his opponents in a suit before the king—and is written for the particular purpose of blackening his character. This was a typical procedure in mediæval suits, to throw as much mud as possible and hope that some would stick. Moreover Latimer's account includes—and Nierenstein and Chapman have neglected this—Norton's version of the affair.

In a letter dated 21 March, the king informed the sheriff that the charges against Spencer were dismissed, and directed him to send to him William Wilkins, "upon whome the saide Thomas groundith the matier of his saide accusacioun". The sheriff wrote back to inform the king that the man he required was John Wilkins, a butcher. He gave him a thoroughly bad character, related the various disturbances of the peace in which he had been involved, and sent him to the king. According to the sheriff's letter, Wilkins was a persistent and incorrigible law-breaker, (and yet after several outbreaks he had been made Watchman!). Some six months before the incident between Norton and the mayor, some fellow prisoners had laid information that Wilkins had often alleged that the mayor, William Spencer, was disloyal, having £400 of the late Duke of Clarence, and £300 of the Earl of Warwick's, which should have been forfeited to the king. On examination Wilkins affirmed he had only said that if he were free he would cause the mayor to come before the Prince's Council, but would not say why[72].

After accusing the mayor of treason Norton had tried to contact Wilkins, but being rebuffed by the keeper had passed messages to him through his wife. Apparently he was relying on Wilkins' evidence to sustain his suit. When the

[70] (William) *Adam's Chronicle of Bristol*, 1623, ed. F. F. Fox, Bristol, 1810, p. 73.

[71] Nierenstein and Chapman, *Isis*, *op. cit.*, p. 318.

[72] He also admitted to calling the mayor "Apis face".

king examined Wilkins, however, he spoke well of the mayor and made no accusations against him. However, Thomas Norton was not beaten yet, and, as the "Remembrance" puts it, "he contrived fals froward and senestre billes of compleynt" against the mayor and presented them to the king. The "Remembrance" includes one of these.

In this, Norton complains that after receiving the king's letter dismissing the charge of treason, Spencer has arrested himself and some followers on the grounds that they were his retainers, in spite of the fact that the same charge had been laid against the same persons previously, and they had been tried by a former mayor, John Shipward, in the presence of the recorder, Spencer and others, and been acquitted. Norton claims that on this previous occasion they were "examyned sodenly severally and secretly . . . at the which tyme it was plainly proved and founde bi that examinacioun that all suche promise as they had made with me was no Reteignor but Rightfull playn and laufull dealinge for whiche they were then and there clerely dismissed". He goes on to explain that as customs officer he had arranged a special search to be made by two men for cloth smuggled out of Bristol by land "to other of youre portes uncustomed". This had never been done before, and his two men had seized nine cloths belonging to the mayor, William Spencer. These, of course, were forfeited, and when Norton refused a bribe from Spencer of a hogshead of wine to conceal the fact, the mayor had retaliated by thus indicting his followers of wearing his livery.

Of the affray between his followers and the bailiff of Temple fee on the Sunday before his accusation against the mayor of high treason, Norton gives his account. He says that the merchants did their best to evade customs duty by shipping their goods at night, with the connivance of the sailors. The sailors were violent with his searchers, and the mayor was misusing his authority to terrorize anybody from joining with himself as customs officer to prevent this smuggling; in this he had the support of the other merchants. The arrest of his followers on the morning after the fight with the bailiff was an instance; only one was involved, the bailiff had begun the fight, and each of the combatants had a broken head and no other injury. The king, however, still dismissed the accusations, and ordered the recorder, John Twynyho, to conduct a final investigation into the matter so that all grudges might cease—an investigation for which Norton, at the abrupt close of the document, had not appeared.

There are, then, the two accounts. Apparently Thomas Norton the "Customer of Bristol" was not the most discreet and soberly-behaved of men, yet one need hardly accept at face value the "character-reference" given on a customs officer by a council of merchants who, as the first page of the *Ordinall* has it, "dwell in the fire of burning covetousness". The smuggling story is plausible, and if Norton was the malicious instigator of the whole affair, then surely he managed it very badly. It might equally well be argued that he took too hasty action without preparing his ground. Furthermore his challenge was not a

rude and boisterous affair, as might be imagined. He entered the "Countir" with two yeomen, and asked if he could speak to the mayor privately; when this was refused he sat down by the mayor and sheriff "and saide secretly I must speke haynouse wordes and therefore I woulde fayne be in a more secrete place". Then he stood up and read his accusation "as softely and secretly as he coude devise with right a base voice". It is true that the king judged against him, but he was clearly outflanked, as John Twynyho who advised the mayor was "generall Attourney to oure derrest sonne the Prince".

However, allowing the worst that is said against Norton, to what extent must we regard him as disqualified from being the author of the *Ordinall*? The author frequently insists on the holiness of the pursuit of alchemy. An oath of dreadful secrecy is exacted from the learner lest any unworthy person should gain knowledge of the processes, even though God will allow only a virtuous man to gain the grace to succeed. Deceit and especially violence are incompatible with the science, and any wantonness or lechery, even by servants, is disastrous. To cap it all we are told:

> "Next after his Saints, our *Lord* doth him call
> Which hath this *Arte* to honour him withall"[73].

If the Bristol burghers were right about Norton, he would seem singularly ill-qualified to study and succeed in the "blessed science", and for such a person to write the pious phrases so liberally scattered through the poem seems to Nierenstein and Chapman past belief.

Yet must we take these pious phrases at their face value? Alchemy was often suspect, if not actually forbidden, in the middle ages. Apart from the numerous fraudulent pretenders whose existence the serious alchemists freely admitted, the whole system was too nearly allied to the occult to be generally approved[74]. Consequently the defenders of alchemy strove to counter the atmosphere of suspicion by exaggerating the piety of their work. Hermes, the legendary founder of the art, became a sort of (though unfortunately pagan) prophet, and recognized prophets and saints such as Moses, St. Dunstan, and St. Thomas Aquinas, or near-saints like the Blessed Ramon Lull and Albertus

[73] Ashmole, *op. cit.*, p. 33.

[74] It is true that an alchemist could defend himself and his use of natural magic by the authority of St. Thomas (see Thorndike, *op. cit.*, II, p. 348), but the line between lawful and unlawful arts—such as necromancy and geomancy—was probably not so clear to the layman, and perhaps the common, even educated, opinion is that of Langland—an educated man: Dame Studye is speaking,

> "Yet ar there fybicches in forceres of fele mennes makynge,
> Experimentz of alkenamye the poeple to deceyue;
> If thow thinke to Dowel dele ther-with neuere".

(B-text, X, 211–13. The whole passage on the sciences, 207–17, is interesting).

Magnus[75] were claimed as alchemists. The insistence on the holiness of alchemy and alchemists was a part of the mediæval tradition of alchemy. This association with religion and mysticism goes back to Greek alchemy[76]. It seems likely then that a writer, deeply read in the literature of alchemy and setting out to make his own contribution to it, could hardly have failed to echo the traditional tone and sentiments of that most traditional brotherhood, the alchemists. An alchemical tract, says Thorndike, "was likely to be in its inception a typical and stock performance rather than an original and personal contribution"[77]. More than that, Norton could quite easily come to believe in his own piety and good intentions, however bad he was in fact, since human capacity for self-deception in such matters is almost unlimited.

Besides, one must take into account the age in which Norton lived. High principles and low practice were then apparently even less incompatible than at other times. The general atmosphere of violence, the oscillation between chivalry idealism and avarice, are vividly described by Huizinga[78]. The contrast between the genuine interest in chivalry, courtly love and respect for women among the aristocracy, and their actual behaviour in war and marriage was a commonplace. Yet even though it was a commonplace, the unfolding by literary scholars of Malory's sordid career of rape, robbery and imprisonment came as a shock in view of his chivalrous romances collected and published by Caxton as *Morte Arthur*[79]. Therefore, reasons based on character, whether wrongly interpreted or not, cannot have any weight in deciding the question of authorship. I believe we must conclude that the *Ordinall of Alchimy* was written by Thomas Norton of Bristol, gentleman of the king's privy chamber, and great-grandfather of Samuel Norton.

It is true that statements have been made about the alchemist Thomas Norton which do not fit Thomas Norton the customs' officer of Bristol. Nierenstein and Chapman mention[80], for example, Borel's reference to Thomas Norton, an alchemist who "claruit anno 1447"[81], and the statement of a Bristol historian, John Evans, that Thomas Norton the alchemist died in 1446[82]. But since Borel's entry continues: "Vide eius opus in Tripode aureo Michaelis Maieri", his date must be a misprint for 1477, and the work he calls "de transmut. metallorum, liber vnus" may well be simply the *Ordinall*. As to Evans, he gives no

[75] Now, of course, St. Albert.

[76] See F. Sherwood Taylor, *The Alchemists*, pp. 56–66.

[77] Thorndike, *op. cit.*, III, p. 40.

[78] J. Huizinga, *The Waning of the Middle Ages*, 1924. Especially Chapter VII.

[79] For an interesting account see Richard D. Altick, *The Scholar Adventurers*, New York, 1951.

[80] *Isis*, *op. cit.*, pp. 314 and 294.

[81] Pierre Borel, *Bibliotheca Chimica*, Paris, 1654, p. 168.

[82] John Evans, *A Chronological Outline of the History of Bristol*, Bristol, 1824, p. 104

evidence in support of his statement, and it is clear that he has fallen into the usual confusion between Thomas Norton the Member of Parliament of 1436, and his nephew Thomas the author. The former's will was proved in 1449, so that he presumably died not earlier than 1448; Evans' dates do not seem very reliable[83]. More disturbing at first sight is the statement of another Bristol historian, William Barrett, who wrote that "some say that he ruined himself and friends who trusted him with their money, (not unusual with these enthusiastic alchymists) and died very poor in 1477"[84]. As pointed out by Nierenstein and Chapman, this was copied by Waite[85], and is referred to in the *D.N.B.* article.

But although Barrett gives no authority for his statement, it seems obviously derived from Fuller, who says that Norton was traduced by Pits and others, who charge "that he undid himself, and all his friends who trusted him with their money, living and dying very poor about the year 1477"[86]. When this statement is traced back still further, to "J. Pits", we find it is indeed stated, on the authority of Robert Recorde, that: "in hanc vanissimam artem miser impegit . . . suam etiam sine dubio substantiam, et eorum qui ei crediderunt, bursas exhausit et exinanivit", but that there is no mention of his date of death, simply the additional statement: "Floruit anno salutis reparatae 1477[87]. Here then we have an instructive example of the growth of a legend. A writer in the 15th century states that he began his poem in 1477. In the early 17th century, a cataloguer, knowing no other date, says the poet "flourished in 1477". A 17th century historian expresses this information somewhat differently, "living and dying . . . about the year 1477", and thereby misleads a 18th century antiquary into the error that Norton "died . . . in 1477".

There were other Nortons in Bristol. A William Norton, for example, who died in 1407[88], does not seem to have been connected with the prominent Norton family, and attempts have been made to identify the alchemist with such Nortons, not members of the Customer of Bristol's family. From the time of Ashmole's note upon the "merchaunt's wife"[89], the story has been repeated that the lady who robbed Norton of the Elixir of Life was the wife of William Canynges, the prominent merchant who rebuilt the church of St. Mary Redcliffe, and was five times Mayor of the borough[90]. It was apparently this

[83] See Nierenstein and Chapman, *op. cit.*, p. 307, f.n. 84, for his confusion of 1549 and 1551.

[84] William Barrett, *The History and Antiquities of the City of Bristol*, Bristol, 1789, p. 625.

[85] A. E. Waite, *Lives of Alchemystical Philosophers*, London, 1888, p. 132.

[86] Thomas Fuller, *History of the Worthies of England*, London, 1662, III, p. 65.

[87] Pits, *op. cit.*, I, p. 666.

[88] Rev. T. P. Wadley, *Notes or Abstracts of the Wills . . . in . . . The Great Orphan Book and Book of Wills*, Bristol, 1886, p. 82.

[89] Ashmole, *op. cit.*, pp. 441–2.

[90] *D.N.B.* IX, pp. 8–10 of the article on William Canynges.

alleged connection with Canynges that led Samuel Lucas to suggest in his *Secularia*[91] that perhaps Thomas Norton was the same man as the Norton who was "master-mason" of Redcliffe church, from whom William Wyrcestre gathered the particulars about the North porch published in his *Itinerary*[92]. This suggestion would scarcely warrant attention but that it appears in the *D.N.B.* article, in Holmyard's edition of the *Ordinall*[93] and in the discussion by Nierenstein and Chapman[94]. The evidence is indeed, as they say, slight; it depends wholly on the translation of "magister" (. . . "per relationem Norton magistri ecclesiae de Radclyff") as "master-mason", in a footnote by Dalloway, the Bristol historian[95], and while the *Mediæval Latin Word List* gives some support for translating "magister" as "master-workman", yet, in Du Cange, the phrase "magister ecclesiae" is given, with the meaning "magister custos"—sacristan. This latter translation is much more probable, since the work on the church was completed before 1466[96], while William Wyrcestre's investigations were conducted in 1478[97]. There is no reason to associate the sacristan with Canynges. Dalloway himself says that the alchemist, Thomas Norton, was a native priest of Bristol[98], but nobody seems to have ever taken this seriously. There has been, therefore, no plausible identification of Thomas Norton with any Norton other than of the great trading family of that name. Among the Nortons I have been able to trace in the period (of Norton-Conyers; of Sharpenhoe, Beds.; of Kettlethorpe, Yorks.; and another Bristol Norton) the only other Thomas possibly able to have written about 1477 is Thomas Norton of Kettlethorpe, 1461–1502[99].

Two titles, those of knight and "water holder", have been applied to Thomas Norton, the Customer of Bristol. He was certainly not a knight, in spite of Bodleian MS. Ashmole, 1445, ii[100], for he is described several times in the

[91] William Lucas, *Saecularia, or Surveys on the Mainstream of History*, London, 1862 p. 125.

[92] J. Nasmith, ed., *Itineraria Symonis Simeonis et Willelmi de Worcestre*, Cambridge, 1778, p. 244.

[93] On page iv.

[94] *Isis, op. cit.*, p. 304, f.n. 68.

[95] Rev. James Dalloway, *Antiquities of Bristow in the Middle Centuries*, Bristol, 1834, p. 133, f.n.

[96] J. J. Simpson, "St. Peter's Hospital, Bristol", *Trans. Bristol and Glouc. Arch. Soc.*, XLVIII (1926), p. 206.

[97] *Ibid.*, p. 202.

[98] *Op. cit.*, p. 210.

[99] J. W. Walker, ed., "Yorkshire Pedigrees, G–S," *Pubs. Harl. Soc.*, 1943, Vol. 95, p. 297.

[100] Ashmole, *op. cit.*, p. 438, has a somewhat inconclusive note about Sir Sampson Norton and his eight brothers, all knights. This Sir Sampson must have owned land in Somerset, where he was sheriff in 1495, but was apparently related to the Yorkshire Nortons.

"Remembrance" in copies of official letters as "Squier" and "Esquier"[101]. The expression "water holder" is a misapprehension passed on to Nierenstein and Chapman by Latimer[102]. It arose from the narrative in the early part of the "Remembrance", when, having described the mayor and sheriff consulting, it goes on: " . . . came unto them Thomas Norton of Bristowe before said Gentleman Water holder and William Banner of the same Towne yomen desireng to speke with the said Maire . . . "[103]. In letters written to the king these two yeomen appear as "Watkyn Holder and William Bannar" on two occasions[104]. Yet even the present editor of *The Great Red Book of Bristol* seems to have fallen into the error of supposing the proper name to be a title, for when, in the copy of the king's letter to the mayor, the name is spelt in the modern form, Walter Holder, he inserts a (*sic*) after the Christian name[105].

Of another part of the traditional account of Norton, that he was a pupil of George Ripley, Canon of Bridlington, who wrote *The Compende of Alkemie*, it is not possible to be certain. The belief dates from the 16th century, and was believed by Francis Thynne in 1574. Furthermore B.M. MS. Royal 18b xxiv and Bod. MS. Ashmole 57, in their lists of "Authors Recited in this Booke" include Ripley; since there is no mention of Ripley by name in the *Ordinall*, the scribes (one of whom was Dee according to Ashmole) probably thought it was he whom the writer referred to as "my master". Ashmole says plainly that Norton's master " . . . is generally thought to be Ripley"[106]. Samuel Norton, however, in the passage from his "Preamble" quoted above, is quite clear that his great-grandfather's master and "our Noble George Riplie Chanon" are two different people, while Maier in 1617 says simply of Norton's master, "an ille *Ripleus* fuerit, nec ne, ignoratur"[107]. Moreover, Ripley apparently communicated his secret knowledge to another person apart from Norton[108], who, as well as Norton, outlived him; whereas, according to Norton, each master must pass his secret on to one person only[109]. The probabilities seem to be against this feature of the Norton tradition.

Nierenstein and Chapman, in dealing with Samuel Norton's evidence, say that they can find no evidence that Thomas Norton was a member of the privy chamber, that he acted on embassies, or that he fled to Bergundy with Edward

[101] See *Bristol Record Society's Publications*, XVIII, pp. 62, 65, 74, 75, 76, 88.

[102] *Op. cit.* Quoted by Nierenstein and Chapman, *Isis, op. cit.*, p. 317, f.n. 138.

[103] *Op. cit.*, p. 58.

[104] *Ibid.*, pp. 63, 67.

[105] *Ibid.*, p. 93.

[106] Ashmole, *op. cit.*, p. 438.

[107] *Symbola Aureae Mensae*, 1617, p. 478.

[108] Sherwood Taylor, *The Alchemists*, p. 130; this was the last Prior of Bath.

[109] Ashmole, *op. cit.*, p. 14.

IV in 1470[110]. With regard to this last point, Samuel's words do not necessarily mean that Thomas Norton left the country, but that when the king fled, his fortunes were at a low ebb. Again, as to embassies, the Privy Council Records are missing for all these years and were not recommenced until well into the reign of Henry VIII; probably a long search in the Public Records Office would be required to find official documents mentioning Thomas Norton. The mention by Samuel of "the privie chamber" seems to have caused the widespread mistake that Thomas Norton was a Privy Councillor, and certainly if he were, his agitated demeanour when brought before the Council, as the "Remembrance" describes it, was strange. According to the *N.E.D.*, the "gentlemen of the privy chamber" were instituted by Henry VII and comprised forty eight servants of the king. But Samuel Pegge in his *Curialia*[111] says that these were the same as the "Squyers of Houshold" mentioned in the "Liber Niger Domus Regis Angliae" of Edward IV's time[112]. According to Pegge, they were still called "Esquires of Houshold" under Richard III, but in the Eltham Statutes of 1526 they were called gentlemen of the privy chamber[113]. Not only were they in constant attendance on the king, but were "likewise employed in confidential offices without doors, as occasion required"[114]. Theirs was a much less exalted office than that of privy councillor, and their title fits in with the description which, according to the "Remembrance", Norton gave of himself as "of the king's household"[115].

It is clear that in the accounts of Thomas Norton, author of the *Ordinall of Alchimy*, fact and error have been almost inextricably intertwined. To Nierenstein and Chapman we owe gratitude for having pointed out the inconsistencies in the traditional accounts—due mainly to confusion between different Thomas Nortons of the same family—and for drawing our attention to a number of documents which provide primary source material for the Nortons of Bristol. Their denial, however, of the authorship to any Thomas Norton of the well known Bristol family, and their rejection of the "Maier-Ashmole hypothesis" which makes the author Thomas Norton of Bristol, these cannot be sustained. The re-examination of their evidence here leads to the conclusion that the author of the *Ordinall* was indeed Thomas Norton, Customer of Bristol. We may therefore conclude with listing the few facts which we know of his life.

[110] *Isis, op. cit.*, p. 317.

[111] Samuel Pegge, *Curialia: or An Historical Account of Some Branches of the Royal Household*, London, 1782, p. 47. I am indebted to the editor of Ambix for this reference.

[112] Pages 13–86 of *A Collection of Ordinances and Regulations for the Government of the Royal Household*, published by The Society of Antiquaries. London, 1790. The duties of the forty squires of household are described on pp. 45–46.

[113] Pegge, *op. cit.*, p. 50.

[114] *Ibid.*, p. 51.

[115] Bristol Record Society's Publications. XVIII, p. 69.

His date of birth is not known, but Samuel Norton says that he was one of the three alchemists mentioned in the *Ordinall* (in Chapter V). According to the *Ordinall* these three had perfected their red and white elixirs, and were near Leadenhall together at the time when "the chaunge of Coyne was had"[116]. Elsewhere in Chapter V Norton says that his master hesitated to teach him concerning the "*Red Stone*", since he was only barely twenty eight, but that he was finally persuaded to teach this final step to him[117]. Brice began his work at the mint early in 1466, so that if Samuel is correct, his great-grandfather, Thomas, must have been born in 1437 at the latest. If he was the Thomas Norton esquire—as is likely—who was a witness to a transfer of property on the Sunday after St. Lawrence (10 August) in 1454 at "Sutton Maundevyle" in Wiltshire[118], a date even earlier is necessary, since he was presumably of age for his signature to be valid. Assuming he was the youngest of the three alchemists at Leadenhall, and was born "under a cross at the end of shires three", the most likely place is Colerne in Wiltshire, the nearest village to the county boundaries of Somerset, Wiltshire and Gloucestershire[119].

Some other dates are those given by Nierenstein and Chapman. Norton receives a bequest from his uncle, Thomas, in 1449, and in 1458 and 1466 there are references in the *Great Red Book of Bristol* to his father's transference of property to his younger son. These have been dealt with above. On 26 May, 1463 the king issues a commission to six men and the Sheriffs of Somerset and Cornwall, to arrest a number of people, including a Thomas Norton, and bring them before the king in Chancery; but this Thomas Norton is not called esquire, or gentleman, and so is probably not our man[120]. It is very probable, however, that our author is the Thomas Norton who was Sheriff of Somerset in 1476 and 1477[121], and a member of the Commission of the Peace for the same county in 1475 and 1476[122]. Another entry in the Patent Rolls shows him and Thomas Croftes to be collectors of customs and subsidies in Bristol, 3 December, 1477[123], and we know he is still holding this office in 1479. Also in 1477 on the 29 April, he is made a commissioner to examine and take over for the king the lands of Thomas Burdet, guilty of high treason, in Gloucestershire[124].

[116] Ashmole, *op. cit.*, p. 52.

[117] *Ibid.*, p. 88.

[118] *Calendar of the Close Rolls*, Henry VI, Vol. 6, p. 434.

[119] I have found a reference to a cross there in the 13th century. An assize judge in one of the years 1267–72 heard cases "at the leaden Cross". (See *Victoria County History*, Wiltshire, V, p. 65.)

[120] *Cal. Pat. Rolls.* Edward IV, 1461–7, p. 278.

[121] Rev. William Phelps, *History and Antiquities of Somersetshire*, London, 1836, I, p. 72.

[122] *Cal. Pat. Rolls.* Edward IV, 1467–77, p. 629.

[123] *Ibid.*, 1477–85, pp. 22, 71.

[124] *Ibid.*, p. 50. I have not found any official record of his doing the same for the Earl of Warwick's lands in Somerset after Tewkesbury, as the "Remembrance" states.

Apart from such official appointments, he is mentioned in the will of his father-in-law, John Shipward, 14 December, 1473, where his wife Joan is made legatee, by a possible second reversion, of the property in case the son John should fail to carry out the testator's wishes[125]. A little over two years later, Stephen Martyn, "sherman" of Bristol, made a gift of all his goods and chattels to Thomas Norton, esquire, and John Gourney, merchant, each of Bristol, on 8 February, 1476[126]. His name occurs in other Bristol wills of the period not as a beneficiary, but simply as owning property next to which was property mentioned in the wills. From such documents we learn that he owned a "tenement" on or near "Worshuppstrete" in 1471[127]. But I find no further mention of any appointments he received, or how long he held the post of Customer at Bristol. It may be that he lost royal favour after his quarrel with the mayor, or it may be that since Edward IV died three years after, and Richard III had a short reign, there was less chance of promotion for Yorkists under Henry VII.

His will is dated 26 November, 1513 and includes a bequest "To the gyldyng of thymage of St. Jamys[128] at the High Auter of St. Peter's as much money as shall be necessary for performing of the same". His son Andrew was to find a secular priest daily to sing for his soul and for the souls of his ancestors at the altar of St. George[129]. It does not appear from this that he was in dire poverty at his death, as Pits said. At the inquisition *post mortem* at Yeovil, 24 April, 1514, it was found that he died in possession of one third of the manor of Kingston-Seymour, Somerset, and the advowson of the church, which his son Andrew inherited[130]. He died, therefore, either late in 1513 or early in 1514, and if our calculation of his birth date is approximately correct, he must have been at least approaching his eightieth year, and this would justify Samuel Norton in calling him *provectae aetatis*[131].

Such, then, are the facts we know of Thomas Norton of Bristol, who wrote the *Ordinall of Alchimy*, beginning it in 1477. What other works he may have written we do not know. Besides the *Ordinall* (which they call *Epitomen Alchymiae*) Bale speaks of a "De transmutatione metallorum", and "alia

[125] Wadley, *op. cit.*, 1886, pp. 160–61. Perhaps John Shipward was not quite so hostile to his son-in-law as the "Remembrance" makes out.

[126] *Cal. Close Rolls.* Edward IV, Vol. II, Item 1574.

[127] Wadley, *op. cit.*, p. 146.

[128] Was this the Statue of St. James before which Norton swore secrecy to the monk of Normandy? *cf.* Ashmole, *op. cit.*, p. 24.

[129] Wadley, *op. cit.*, 1890, p. 73.

[130] Rev. J. Collinson, *The History and Antiquities of the County of Somerset*, Bath, 1791, II, p. 123.

[131] The phrase occurs in the Vulgate, Gen. xviii, II, where the A.V. has "well stricken in years".

quaeda(m)"[132], and to these Pits adds a third, "de Lapide Philosophico", adding "Et id genus alia multa"[133]. It is interesting to note that Borel, referring to "Th. Nortoni de transmut. metallorum, liber vnus"[134], is apparently referring to the *Ordinall*. In addition there is a manuscript mentioned in the first Report of the Historical Manuscripts Commission, among the books and papers of the Earl of Winchilsea and Nottingham, described as: "Another book of poetry, headed 'Mr. Norton's work de lapide ph'orum' "[135]. This manuscript was examined by Nierenstein and Price[136], and they found it to be one and the same work as the *Ordinall*. They conclude that there "remains, therefore, only one more work of NORTON'S so far not identified, namely, "De transmutatione metallorum"[137]. Although a single manuscript does not constitute absolute proof, their opinion that "de lapide philosophorum" (corresponding to Pits' "de Lapide Philosophico") is not a separate work may be accepted as a very reasonable inference; and we may also infer from the evidence of Borel that the "De transmutatione metallorum" is likewise merely another name for the *Ordinall of Alchimy*.

I wish to express my thanks to the Marquess of Bath for permission to quote from Longleat MS. 178, and to the Trustees of the British Museum, the Keeper of Western Manuscripts at the Bodleian Library, and the librarian of the Wellcome Historical Medical Library, Dr. F. N. L. Poynter, for permission to quote from manuscripts in their charge; also to the editor of AMBIX for a number of corrections and helpful suggestions.

[132] *Op. cit.*, ii, p. 67.

[133] *Op. cit.*, p. 666.

[134] *Op. cit.*, p. 168.

[135] *Hist. MSS. Comm. 1st Report*, 1870. Appendix, p. 32, Col. 2.

[136] M. Nierenstein and Frances M. Price, "The Identity of the Manuscript entitled 'Mr. Norton's worke, *de lapide ph'orum*' with the Ordinall of Alchimy." *Isis*. No. 60, Vol. xxi, I, 1934, pp. 52–56.

[137] *Ibid.*, p. 53.

GNOSTICISM AND ALCHEMY

By H. J. Sheppard

That there was an esoteric side to alchemy is surely undeniable; that this arose among the Alexandrians of the 2nd century A.D. as a result of the mutual interaction of early chemistry and Gnosticism might be less readily acceptable if we judge by the concluding remarks in a recent contribution to this Journal: "It is also obvious that Hellenic chymeutike has no connexion whatever with Alchemy and that the name of alchemists cannot be used for the Hellenic chymeutes". The writer, Professor P. D. Zacharias[1], sets out to show the origin and development of early chemistry (*chymeutike*) in Greece and Hellenized Egypt; in the main he follows the argument of Stephanides[2] against the Berthelot interpretation of the papyri and manuscripts, though occasional references to out-dated or less-informed writers such as Hoefer and C. J. S. Thompson must invite considerable caution in their acceptance.

If the thesis is true, the conclusion must be much the same as that of the late Tenney L. Davis[3], that only after the rise of Islam did alchemy develop outside China; up to that time the craftsmen of Alexandria had evolved processes for the simulation of silver and gold but no attempts at genuine transmutation had followed.

Unfortunately, this viewpoint takes no account of, or mis-interprets, philosophical ideas clearly discernible in some of the earliest texts, such as the *Physika kai Mystika* of Pseudo-Demokritos. In addition, when discussing the condition of *chymeutike* during the first three centuries of the Christian era, Zacharias states that "Their books were more or less affected by religious mysticism and the tendency to popularize the natural phenomena by comparison with the proceedings of human life"[4]. "Their books" were the note-books and records of the earliest Hellenic *chymeutes* which had managed to survive the troublesome times leading up to the establishment of the Byzantine empire. And it was precisely during this period that there arose the interaction between chemistry and Gnosticism which was responsible for the combination of the exoteric and esoteric natures which characterized Western alchemy thenceforth.

[1] P. D. Zacharias, Ambix, V (1956), p. 128.

[2] *Contributions to the History of Physical Knowledge, and of Chemistry in particular*, by Michael K. Stephanides. Athens, 1914 (in Greek).

[3] "Pictorial representations of alchemical theory", *Isis*, XXVIII (1938), p. 74; *Scientific Monthly* (1936), XLIII, pp. 551–58.

[4] *Op. cit.*, p. 125.

Ample evidence for this is furnished by the fact that the origin of much of the symbolism of late alchemical literature is to be found in the mystico-religious thought of Graeco-Egyptian times—indeed, even in the early texts which we must regard as alchemical.

Late Western alchemy appears to offer two concomitant themes: the transmutation of base metals into gold (which is regarded as the ultimate stage in a process of perfection, or regeneration), and a quasi-religious conception of the regeneration of the soul, otherwise regarded as a spiritual perfection. It was these which gave rise to the two extreme schools of interpretation which existed before the first serious research was undertaken by Berthelot and later scholars. The one school, materialistic, regarded alchemy as a chemical process at times veiled allegorically in terms of religious experiences, while the other, mystical, conceived of it as a spiritual process couched in the language of chemistry. The two views represented broadly the standpoints of early modern scientific interpreters and of occultists (principally theosophists) respectively.

The only major English work which attempted to decide between the two views is that of the late A. E. Waite: *The Secret Tradition in Alchemy*. Notwithstanding the undoubted brilliance of Waite as an expositor of Christian mysticism, his essay must be regarded as a failure—at any rate, as far as alchemy up to the end of the Renaissance is concerned. In brief, he concluded that only after the beginning of the 17th century could alchemy be regarded as the concern of religious mysticism; up to that time it was purely a matter of chemical practice.

Considering Waite's acquaintance with alchemical literature this is rather surprising, though the reasons appear obvious enough: absence of a critical examination of the philosophical principles upon which attempted transmutations were based; an apparent lack of knowledge of the Gnostic texts and critical works on them which were available even when he was writing (1926); and his disdain of many mystico-religious ideas which, though of non-Christian origin, could be readily assimilated to the mystic views of the later Christian alchemists. It is possible that he was prejudiced by the uncritical writings of authors such as, for example, Mrs. Atwood[5]. However, his examination of the Berthelot-Ruelle collection was sufficiently uncritical to cause him to come down on the side of the chemical intent of alchemy more heavily than did Berthelot.

It is interesting to note that a contemporary of Waite—H. S. Redgrove, a chemist by training—in an essay entitled "The Quest of the Philosopher's Stone"[6], formed the opinion that the "regeneration" of metals and of man could be regarded as parallel developments of two aspects of a striving after

[5] *A Suggestive Inquiry into the Hermetic Mystery*, London, 1850.

[6] *Bygone Beliefs*, London, 1920, Chap. IX.

unity within the Cosmos—a "Unity in mind and life". Based chiefly upon his interpretation of the symbolism of mediæval and later texts, Redgrove's thesis, though purely speculative, is highly plausible.

Late mediæval, Renaissance and post-Renaissance texts, viewed in isolation, are sufficiently abstruse to allow of almost any speculative interpretation. This is very evident from the writings of 19th century French devotees of what Dean Inge termed "that unwholesome development of 'symbolic science, falsely so-called', which has usurped the name"[7]. Any semblance of truth in such occult reveries can be regarded as purely fortuitous, for in true occultist fashion reason, though legitimately divorced from revelation, finds equally little place in the examination and interpretation of historical material. For conclusions to be of value the mystical elements portrayed in late alchemy must be shown to derive from early alchemical origins wherein their meanings are comprehensible, rationally or intuitively, from the intellectual and spiritual backgrounds of the time.

The use of the terms "mystical" and "mysticism" may introduce some ambiguity unless they are defined. Here they will be restricted to ideas of a supra-rational nature concerning the origin, nature and destiny of the soul, irrespective of the conception of deity which prevailed at a particular time. Only by showing the origin of such ideas in the early stages of alchemy can we legitimately conclude that it was thought to be concerned with more than the material art of goldmaking. To show that these ideas arose from the fusion of exoteric alchemy with Gnosticism is the purpose of this paper.

The Influence of Greek Philosophy and Oriental Beliefs Upon Egyptian Technology

Processes for the simulation of silver and gold formed part of traditional practices in Egypt which are believed to have started as early as 500 B.C.[8] In general method they are thought to have differed little from those described in the well-known Leiden and Stockholm papyri, the literary style of which suggests that they were compiled between 250 and 350 A.D. from much earlier records[9]. From around 200 B.C. attempts were made to extend the processes of superficial colouring (tingeing) to genuine transmutation by applying methods evolved as a result of theorizing upon the changes envisaged. It is impossible to say precisely when this first took place; Wellmann[10] has suggested that the

[7] W. R. Inge, *Christian Mysticism*, London, 1899, p. 344.

[8] Zacharias, *op. cit.*, p. 120; J. Bidez, F. Cumont, *Les Mages Hellénisés*, Paris, 1938, I, Part 2, *passim*.

[9] *vide* A. J. Festugière, *La Révélation d'Hermès Trismégiste*, Paris, 1950, I, p. 221.

[10] M. Wellmann, "Die φυσικα des Bolos Demokritos und der Magier Anaxilaos aus Larissa", *Abh. d. Preuss. Ak. d. Wiss.*, Phil.-Hist. Kl., 1928, No. 7.

first in the field may have been Bolos of Mendes (ca. 200 B.C.), whose work on the tinting of metals, *Baphika*, may have served as the source of both the technical contents of the papyri and of the theory and practice contained in the text of the Pseudo-Demokritos. Certainly, there are many striking resemblances between all these works, though, as Festugière remarks[11], there is at present insufficient evidence to suggest any more than this.

By the 2nd century B.C. Greek rationalism was slowly declining[12]. The disputes between the many schools of philosophy had led to an attitude of scepticism on the part of the ordinary man, to whom it seemed that there could be but one true explanation of the mechanism of nature. Discounting reason, he was left with recourse to one source only—the gods, from whom he sought the truth through revelation.

For such an attitude of mind the Egyptian milieu was particularly favourable; the conquest of Egypt by the Persian Cambyses in 525 B.C. led to the infiltration of Magian beliefs, which, together with the Oriental influences following the campaign of Alexander the Great in 333–331 B.C., readily lent themselves to the new outlook. What was now sought in science was a knowledge of the hidden relationships between natural objects—the forces acting among them, and between them and the greater universe—a knowledge which it was felt could come only from the gods themselves.

Astrology provided the solution; established by the Chaldaeans in the 6th century B.C., its basis was a primitive animism which, as Cumont says, established "hidden and unexpected relations which it is the object of magic to discover and utilize . . . By induction men arrived at the conclusion that even the lesser stars and their conjunctions had a certain connection with the phenomena of nature and the events of human life. At an early time arose the idea that the configuration of the sky corresponds to the phenomena of the earth. Everything in sky and earth alike is incessantly changing, and it was thought that there existed a correspondence between the movements of the gods above and the alterations which occurred here below"[13]. Here was the origin of those laws of sympathy and antipathy which, incorporated into Greek thought by the Stoic Poseidonios (ca. 135–51 B.C.) formed part of the early alchemical theory.

Not only was Stoicism the principal Hellenic recipient of Oriental ideas[14]; it played a greater role than any other philosophical creed in formulating a theory of alchemical change. Indeed, in the opinion of the present writer, as

[11] *Op. cit.*, pp. 222–38.

[12] Festugière, "L'Hermétisme", *Kungliga humanistiska vetenskapssamfundets i Lund årsberrättelse*, 1947–8, I, pp. 12–17.

[13] Cumont, *Astrology and Religion among the Greeks and Romans*, New York, 1912, pp. 12 ff.

[14] Cumont, *Les Religions Orientales dans le Paganisme Romain*, Paris, 1929, p. 165.

we shall see, it was the indirect cause of the introduction of Gnostic beliefs into alchemy.

Of particular importance for alchemy was the Stoic conception that animals and plants reproduce their kinds according to fixed types by virtue of the *pneuma*, or "spirit", operating in each kind in a specific fashion. The principle by which the *pneuma* worked in an individual was termed the *spermatikos logos*, or "seminal formula"; it implied that reproduction of a given type took place from a "seed" through the impelling force of the *logos*, which was regarded as a rational organizing principle founded in the Divine intelligence. To extend this to the mineral world, as did the alchemists, was thus a simple step.

For the Stoics *pneuma* originated as part of God who was Divine Fire (undoubtedly inspired by the ideas of Herakleitos). When part of the Divine Fire condensed and coarsened, the Divine nature was lost and it became the "elements" air, water and earth, out of which the remaining Divine Fire (as "Active Reason") fashioned the Cosmos. At the centre was the world, partially covered by an envelope of Divine Fire from which God interpenetrated the whole of matter in the form of *pneuma*. Eventually the Cosmos would undergo destruction by the Divine Fire but would re-emerge in stages from a remaining "seed" through the action of the *pneuma*[15].

Few of the earliest alchemical texts are free from mystical content, from which it would seem that no sooner was it formulated on a philosophical basis than it either assimilated mystical ideas or was adopted symbolically, in part at least, by mystical circles. However, evidence, in the form of the works remaining from, or attributed to, Pseudo-Demokritos, exists to show that in its initial stages alchemy was free from religious mysticism, though affected by certain Oriental ideas attributed to the Persian Magus Ostanes[16]. From an analysis of Demokritean fragments Festugière[17] has established the parts played by the doctrine of the unity of matter, the Aristotelian conception of change as a result of the imposing of "qualities" upon the *prima materia*, and the invocation of the laws of sympathy in the selection of the appropriate chemical treatment. To these we might profitably add the Stoic ideas of *pneuma* and *spermatikos logos* to build up a complete and plausible picture of the alchemical process.

Starting from a given base metal, or mixture of such metals, it was first necessary to remove specific qualities by the action of heat. The black, molten residue was evidently regarded as the formless *prima materia*, on account of its apparent lack of qualities. In Stoic nomenclature the material had been

[15] E. R. Bevan, *Stoics and Sceptics*, London, 1912; also *Later Greek Religion*, London, 1927, xiii–xviii.

[16] *Mages Hellénisés*, I, Part 2, *passim*.

[17] *Révélation*, pp. 224–28.

"killed"; there then remained within it a dormant "seed" which, by suitable chemical treatment in accordance with the laws of sympathy, could develop. During this development the new qualities acquired were often readily visible to the eye—for example, the series of colour changes discussed by Hopkins[18]. In this process the impelling action of the *pneuma* was aided, as in the animal and vegetable world, by the provision of warmth and moisture. On occasion there was added a small quantity of gold to act as a "seed". Thus there was brought about a development, or regeneration, in which it was thought that gold, the perfection of the mineral world, had been produced.

The Relationship Between Gnosticism and Alchemy

The decline in rationalism and the consequent faith in the power of revelatory knowledge which immediately preceded the Christian era was most strongly marked in the field of religious thought.

By the 2nd century A.D. the movement had reached its apogee in the form of Gnosticism and thereafter declined in the face of growing Christian opposition. The origin of Gnosticism is shrouded in obscurity; Leisegang[19] and others regard it as a vast syncretism in which the Orient provided the religious material and the Greeks the philosophy. Its basic tenet was the belief that true knowledge (*gnosis*) could be attained only through revelation afforded by the Divine God, an ecstatic experience which came "through the eyes of the soul"[20].

The problem which had long confronted man was the origin of evil, and in attempting to solve this the Gnostics were faced with two questions. If evil were resident in matter, and hence in man himself, how could the creation of the world be attributed to an infinite, spiritual God who was perfect? And furthermore, why should such a Creator permit the existence of sin, and by what means can man be delivered from it?

Gnostic works and fragments which remain to-day are, unfortunately, relatively few, and to see how the various sects attempted to answer these questions we must turn to the writings of Church Fathers such as Irenaeus (ca. 133–203 A.D.), Hippolytus (ca. 220 A.D.) and Clement of Alexandria (ca. 155–220 A.D.), all of whom were well acquainted with the tenets of the Gnostic heresy which they were actively engaged in refuting.

[18] A. J. Hopkins, *Alchemy, Child of Greek Philosophy*, New York, 1934; "Transmutation by Colour, a Study of Earliest Alchemy", in "Studien zur Geschichte der Chemie" (*Festgabe E. O. von Lippmann*), Berlin, 1927, pp. 9–14.

[19] H. Leisegang, *La Gnose*, Paris, 1951 (trans. from German edn., Leipzig, 1924); also H. C. Puech, "Où en est le problème du gnosticisme?", *Revue de l'Univ. de Bruxelles*, Nos. 2–3, 1933–4.

[20] Leisegang, *op. cit.*, p. 15.

The relations between God and sin on the one hand, and man and sin on the other, are all to be found in the fantastic cosmogonies of the sects. Though differing considerably in detail, they nearly all possess, in essence, a common plan. The Supreme God was transcendent; by putting forth a series of emanations He gave existence to a number of inferior deities, termed Aeons, who were personifications of attributes of the Divine personality. Within this celestial group, or Pleroma, there occurred a transgression, resulting in the fall of a lesser deity; through the action of this fallen deity the material world, including man, came into existence, partaking at the same time of the sin of its inferior creator, or demiurge. The character of the latter differed considerably from sect to sect. In order that it might return to the source whence it came, man's soul had to be separated from the material which enclosed it; this might be effected through the Divine Logos (or Reason) manifested in the form of Christ incarnate as Jesus, who, by His revelation, would provide the *gnosis* by which the soul might attain the Divine Pleroma[21].

Such a grandiose scheme when illustrated diagrammatically is reminiscent of the quaint world-maps of the late Middle Ages. A ready example is that which is depicted in the Vision of Hildegard of Bingen (1098–1178), described elsewhere by Professor Singer[22].

The detailed accounts of the Church Fathers show clearly the dominant role played by Stoicism, particularly in the doctrines of the Alexandrian Gnostics Basilides, Valentine and Marcos. Especially prominent are the Stoic concepts of *pneuma* and *spermatikos logos*; together, as Sagnard remarks[23], they form the backcloth on which the doctrines of the Valentinians, in particular, were sketched.

Although affirmed by the Stoics, the notion of the soul exiled in a material body, whence it seeks to escape and rejoin the Divinity of which it is a spark, goes back to earlier times—to the *sôma-sêma* dogma of the Orphics[24], from whom it was adopted by the Pythagoreans.

In all this there was stressed a belief in the unity of the world, deriving from the initial emission of the Divine *pneuma*, a unity with hierarchies "like a gradually ascending scale of perfections staged one above the other . . ."[25]. All

[21] *Ibid.*, pp. 26ff.

[22] C. Singer, *Studies in the History and Method of Science*, Oxford, 1917, pp. 1–55.

[23] F. M. M. Sagnard, *La Gnose Valentinienne et le Témoignage de Saint Irénée*, Paris, 1947, p. 581.

[24] W. K. C. Guthrie, *Orpheus and Greek Religion*, London, 1952, pp. 156ff.; Cumont, *Lux Perpetua*, Paris, 1949, p. 245.

[25] G. Verbeke, *L'Évolution de la Doctrine du Pneuma des Stoïciens à S. Augustin*, Paris & Louvain, 1945, p. 142.

things are one, they arose from the One and will return to the One—hence the constantly occurring inscription ἕν τὸ πᾶν.[26]

As we have seen, alchemy and Gnosticism were contemporary in origin, and both drew largely upon the same current philosophy—Stoicism—and Oriental doctrines. Not surprisingly, they were strongly associated with each other; the Leiden papyrus X, already mentioned as an early source of information on the working of gold, forms part of a collection undoubtedly gathered from the same source. Of this collection, one, papyrus V, contains fragments of metallurgical recipes, together with magical words and incantations which Berthelot[27] realised were derived from the Gnostic school of Marcos. Another of these papyri, W, consists mainly of Gnostic expressions which are redolent of the doctrines of Marcos and of the Carpocratians[28]. The association seems to have existed almost from the rise of alchemy, and the explanation is not far to seek.

Like the Stoics, the Gnostics resorted to the allegorical method of exposition, and showed a complete contempt for reality. Seizing upon any suitable material—usually mythical or scriptural—they ignored the facts completely and concerned themselves solely with symbolic meanings of the truths that were thought to lie hidden within. Alchemy offered a particularly fruitful field from which they could draw their similes; based upon the same philosophical ideas, it had, moreover, translated these ideas into practical terms which provided a wealth of picturesque material for the Gnostic interpreters.

In his illuminating study on Valentinian Gnosis, Father F. M. M. Sagnard[29] has pointed out several similes which can only have been borrowed from alchemy and it is worth while to quote most of his remarks on this subject: "the term *ebulliens* applied to Sophia (the Aeon, Wisdom) recalls one of the classical means of separating the pure from the impure. The Spirit (τὸ πνεῦμα) signifies, moreover, in alchemy the product of sublimation, the "sublimate", while τὸ πᾶν indicates the whole process. Sublimations and distillations are currently designated in this field by the terms "above and below". They are precisely the terms that are met with in the manufacture of the world by the Demiurge: "the light and the heavy, those which rise to the top and those which sink to the bottom"[30]. In the whole of this manufacture the Demiurge appears as a genuine alchemist "separating the mixed substances" and "corporifying", as we said, "the incorporeal". The parallel passage from the Extracts of

[26] *Vide* E. Norden, *Agnostos Theos*, Leipzig, 1913, pp. 240ff. for the most complete discussion of this formula. (A new edition of this book was published in 1956 at Stuttgart).

[27] M. Berthelot, *Introduction a l'Étude de la Chimie des Anciens et du Moyen-Age*, Paris, 1889, Part I, p. 8.

[28] *Ibid.*, p. 16.

[29] Sagnard, *op. cit.*, pp. 243–4.

[30] Irenaeus, *Adversus Haereses*, V, 5, 2.

Theodotus[31] notes that he separates "the pure" from "the heavy", from "the muddy", from "the thick". It calls to mind a decantation. But the text of Genesis cited by Theodotus: "The spirit of God was borne upon the waters" evokes, by this very word πνεῦμα, sublimation or distillation; thus, in the same way, ἐπιφέρεσθαι, that Theodotus applies to "the pure", while ὑποφέρεσθαι fits the hylic. It is the exact correspondent to the ἀνωφερῶν and the κατωφερῶν of Irenaeus, well rendered in the Latin, even in its mobile connotation: *sursum advolantium et deorsum devergentium*[32]. The terms: to refine, to filter, to purify, are met with again in the Extracts of Theodotus. The theory of mixtures figures there also. In another field the seed of Gnosis is presented as the embryonic germ, with its organic growth, σπέρμα, κυοφορηθέν ἐκτραφεντα, νήπια, τελειούμενον, αὐξηθέν"[33].

The commentators whom Sagnard quotes are Irenaeus and Clement of Alexandria, presenting the ideas of Valentine and his follower Theodotos. Now, the Valentinian sect flourished late in the first half of the second century, so that they must have been conversant with alchemical texts which can scarcely have been compiled much later than 100 A.D. This immediately calls to mind those alchemists whose existence has, with difficulty, been tentatively fixed in the first century—especially the school of Mary the Jewess. The emphasis placed by this school upon distillation and sublimation, and upon the design of apparatus for carrying out those processes, seems fully consonant with the style of similes employed by the Valentinian Gnostics.

Among the alchemical texts which appeared around the same time that the Gnostics were borrowing alchemical terminology, were some which employed Gnostic expressions and symbolism. Unfortunately, since these texts are only known from citations in manuscripts, none of which appears to be earlier than the tenth or eleventh century[34], we can only conclude from the alchemical style and the symbolism that the authors probably lived between the 2nd and 4th centuries.

From all the practical contents of the works the writers were certainly practising alchemists. Whether or not they were members of a Gnostic sect is impossible to say with certainty; the use of Gnostic symbolism renders it extremely likely. At any rate, in most cases the symbolism employed is subservient to the practical side of the art, in marked contrast to the writings of 4th century alchemists where practice for its own sake appears of little concern.

[31] *Excerpta ex Theodoto*, 47, 3.

[32] Literally: "Of things flying upwards and of things settling downwards".

[33] Irenaeus, *op. cit.*, I, 7, 5; I, 6, 4 to end; I, 5, 6.

[34] F. S. Taylor, "A Survey of Greek Alchemy", *J. Hellenic Stud.*, L, Part 1 (1930), p. 111.

Many of the Gnostic symbols adopted by the early alchemists have been described by Berthelot[35]. One of the most interesting works for present purposes is the *Chrysopoeia* of Kleopatra, wherein occurs the Ouroboros, or serpent which devours its tail. Serpent symbolism is of ancient origin; Hellenistic astrology knew of a serpent, the *draco caelestis* of the Babylonians and Chaldaeans, represented as encompassing the heavens while biting its tail. However, the Ouroboros undoubtedly derives from the sun-serpent of the Phoenicians[36]. Its long life, coupled with the ability to reproduce itself annually, led to the adoption of the sun serpent as the symbol of the cosmic life-span. When the serpent was depicted devouring itself, the analogy to the Stoic doctrine of cosmic creation from, and destruction by, fire was complete, the unity of the process being emphasised by the accompanying inscription ἕν τὸ πᾶν.

Among the first Gnostic sects were some who were serpent-worshippers and styled accordingly as Ophites (Greek: *ophis*—serpent) or Naassenes (Hebrew: *nachash*—snake). Their use of the serpent symbol differed from sect to sect; to some it signified the World Soul enveloping all and giving birth to all which existed; to others it symbolized either Christ or Sophia, while to yet more it was identified with the principle of evil[37]. Gnostic gems and amulets upon which is engraved the serpent may be seen in many museum collections[38].

The feature linking the Ouroboros of the *Chrysopoeia* with Gnosticism is the occurrence in the centre of the symbol of the inscription ἓν τὸ πᾶν—The All is One—the idea of unity, of everything coming from One and returning to One. For the alchemists the ensemble symbolized the work which had neither beginning nor end, and as Sherwood Taylor suggested[39], may well have illustrated the circulatory nature of a process such as distillation.

Accompanying the Ouroboros is a variant of the same symbol, consisting of a ring composed of three concentric circles, the outer of which bears a tail, while in the centre are the planetary symbols for gold, silver and mercury. Within the two spaces formed by the circles are inscribed the axioms: "One is the serpent which has its poison according to two compositions" and "One is All and through it is All and by it is All and if you have not All, All is nothing"[40].

[35] Berthelot, *Les Origines de l'Alchimie*, Paris, 1885, p. 57ff.

[36] Cumont, "De dracone caelesti", in *Catalogus codicum astrologorum Graecorum*, VIII, I (Brussels, 1929), pp. 194 ff; Macrobius, *Saturnalia*, I, 9, 12, discusses the Phoenician origin, and in I, 20, 3, the serpent as symbol of the sun.

[37] C. W. King, *The Gnostics and their Remains*, London, 1887, p. 82; also Leisegang, *op. cit.*, p. 81 ff.

[38] King, *op. cit.*, pp. 231–302 and plates A to O.

[39] Taylor, *op. cit.*, p. 112, fig. 1.

[40] *Ibid.*, Ambix, I (1937), p. 43.

The whole recalls vividly the world diagram of the Ophites, which Origen describes in his *Contra Celsum*[41].

Side by side with the above symbols is a star adorned with eight rays, no doubt derived from the ancient Assyrian symbol for the sun. The Gnostic affinities are Valentinian, notably the use of the number 8, recalling the group of 8 Aeons termed the Ogdoad.

Other fragments of texts attributed to Kleopatra[42]—*Dialogue of Kleopatra and the Philosophers* and *Dialogue of Komarios*—contain mystic themes which are capable of dual interpretation. They may be taken as referring to the death and regeneration of the soul, or, symbolically, to the "death" and "revivification" of metals—or possibly to both, for the writer displays such a leaning towards the mystical side that she (or he!) must have belonged to a Gnostic sect.

Enough has been said to show that soon after the appearance of the first alchemical texts, Gnostic influence was at work, though its absence from the works of other alchemists lends support to the idea that some, though not all, alchemists were themselves members of a Gnostic sect.

By the 4th century the balance between the Gnostic and alchemical contents of alchemical texts had shifted. In the works of Zosimos of Panopolis (ca. 300 A.D.) this is very evident. No longer does the practical side predominate; upon occasion it seems rather as though we are now considering the ideas of a Gnostic to whom practical alchemy had a limited appeal, except insofar as it illustrated his Gnostic tenets. Indeed, the most probable assumption is that, whereas up to that time alchemy had been regarded as a subject suitable for allegorical interpretation as Gnostic doctrine, the increasing interest shown in alchemy by Gnostics had resulted in the conviction that it was truly a Divine Work inseparably linked with religion—as it were, part of a Divine Plan.

The style of Gnosticism changed. Instead of the doctrines of Valentine, Marcos and the Ophites, we find the predominating influence to be Hermetism, of the variety termed "popular" by Festugière, whose recent scholarly studies have done so much to shed light upon a hitherto obscure subject[43].

In all the Hermetic writings authority is attributed to Hermes-Thoth, Hermes the Thrice Great, of whom Tertullian wrote that he was regarded as the fount of ancient wisdom and the pagan prophet of Christian revelation. Though they are no longer regarded as the repository of ancient Egyptian wisdom, the Hermetic writings present their doctrines as a series of revelations coming from Hermes Trismegistos himself. The whole Hermetic Corpus has been translated afresh and edited by Father Festugière and Professor A. D. Nock[44], the former having analysed, in addition, the bearing of Hermetism upon magic,

[41] *Vide* the excellent discussion of this in Leisegang, *op. cit.*, p. 117 ff.

[42] Taylor, *J. Hellenic Stud.*, L, Part 1 (1930), pp. 116–7.

[43] Festugière, *Révélation*, pp. 243 ff.

[44] A. D. Nock and A. J. Festugière, *Hermès Trismégiste*, Paris, 1945.

astrology and alchemy. This is the aspect of Hermetism which Festugière termed "popular".

Throughout the long history of alchemy we find the founding of alchemy constantly attributed to Hermes: "The first, then, is Hermes, known as the Thrice Great, because the present operation is carried out according to three particular manifestations of power . . . He was the first to write about the great mystery . . ." declared the unknown Anepigraph[45], writing in the 7th century.

But this is in accordance with the spirit of tradition. Alchemical fragments attributed to Hermes occur among the earliest works, but they are pseudonymous and have no connection with Hermetism proper. The most significant treatises which are both alchemical and Hermetic are those of the philosopher and alchemist Zosimos, mentioned earlier.

Best known are the Visions which appeared to him in dreams; from the interpolations which accompany his descriptions of the dreams it would appear that there was revealed to him the alchemical means for preparing a "divine water". Psychologically, his experiences offer a rich field for study and have been analyzed in great detail by C. G. Jung[46], who hesitates to class them as pure allegory but regards them rather as the fruits of a meditation based upon dreams which have broken through into the waking state.

The Visions themselves are too lengthy to quote here in full, but a translation by Sherwood Taylor[47] was published in this Journal some years ago; there exists also a German version prepared by C. G. Jung[48].

Zosimos belonged to the Poimandres sect of Hermetists. Among his bizarre dream experiences he heard from the lips of a priest how the latter had undergone death and dismemberment by sword in order that he might be transformed into spirit (*pneuma*). Later in the Visions the priest becomes his own sacrificer; a process of spiritualization in which sacrificer and sacrificed are one, which, according to Jung[49], represents the Unity of the *prima* and *ultima materia* in alchemy. The conception of separating by the sword recalls the Ophite notion of the separation of the earthly cosmos from the fiery (pneumatic) ring containing paradise by means of the "flaming sword"[50].

In the process of self-sacrifice we see an exact parallel with the self-devouring Ouroboros; as Jung remarks[51]: "It begets and sacrifices itself and is its own

[45] Berthelot, *Collection des anciens alchimistes grecs*, Paris, 1888, pp. 424–8 ff.

[46] C. G. Jung, "Transformation Symbolism in the Mass", *The Mysteries* (Papers from the Eranos Yearbooks), London, 1955, Vol. 2, pp. 293 ff.

[47] Taylor, Ambix, I (1937), pp. 88 ff.

[48] Jung, "Einige Bemerkungen zu den Visionen des Zosimos", *Eranos-Jahrbuch*, 1937 (Zurich, 1938), pp. 15–54.

[49] Jung, *Mysteries*, p. 298.

[50] Leisegang, *op. cit.*, pp. 119–20.

[51] Jung, *Mysteries*, p. 304.

instrument of sacrifice, for it is a symbol of the deadly and life-giving water", where, in alchemical language, spirit and water are synonymous.

The works of Zosimos contain sufficient evidence to show that, even if he did not practise alchemy, he was well acquainted with the processes of earlier alchemists. It is reasonably safe to conclude, however, that the stage had been reached when exoteric alchemy was surely regarded as the practical manifestation of an esoteric process. The result was the transmission of a dual art, accompanied no doubt by a vestigial practical craft, which was to provide the pattern for that which arose in Europe in the late Middle Ages.

The Evidence for Gnostic Ideas in Later Alchemy

After the 5th century, Greek alchemical texts showed little advance upon the works of Zosimos and his contemporaries; they consisted mainly of commentaries upon, and compilations of, the works of the earlier schools and are contained in the various manuscripts extant. But following the creation of Islam, there arose a Muslim school which, beginning in the 8th century, drew its inspiration in part from the Alexandrian work transmitted by the Nestorians, and in part from the ancient chemistry of the Ḥarrānites.

Among the many texts composed or edited by the Arabs are several that may be related to the Hermetic tradition that we have just mentioned[52]. Of these only a very small number have been shown to derive from Greek originals —indeed, but a few quotations from the Greek and Latin versions of the Hermetica have been traced in the Arabic works attributed to Hermes. Accordingly, Plessner[53] has posed the questions: "Is it only the continuation of a traditional literary manner that presents itself in the Arabic Hermetica? Or how far can the contents of these writings prove that they are the true successors of their classical ancestors?"

At present the question remains open, though Plessner has shown clearly one example, at least, in which Greek Hermetic tradition, apparently derived from Babylonian sources, was transmitted to the Arabs to form part of their Hermetic writings[54]. The answers to both of his questions depend clearly upon long and detailed analyses of the Arabic texts, coupled with a careful comparison with the Greek Hermetica.

However, the corpus of Gnostic—alchemical writings which eventually reached Europe by the 12th century was sufficiently complete to render the conception of alchemy gained by the recipients a matter for their state of mind.

[52] L. Massignon, in Appendix III to *La Révélation d'Hermès Trismégiste*, lists the Arabic Hermetic literature.

[53] M. Plessner, "Hermes Trismegistus and Arab Science", *Studia Islamica*, II (Paris, 1954), p. 48.

[54] *Ibid.*, p. 50 ff.

PLATE I. By courtesy of Messrs. Kegan Paul

PLATE II.

Reprinted from plate 17 of Professor Read's *Prelude to Chemistry* by courtesy of the author

To the lesser mind, obsessed with cupidity, it must have represented a potentially lucrative, if bewildering, occupation; to the men of fervid religious conviction it held out hopes of personal salvation. To both, no doubt, the practical side of the art was regarded as the central aim, while to the devout the mystic side was the key to Divine assistance in the fulfilment of the task.

The esoteric side of European alchemy consists of a vast edifice of symbolism representing the need for a Christian redemption of man. Gone is the pagan background against which such writers as Zosimos drew a parallel between the alchemical *opus* and the spiritual work of redemption; in its place is a Christian one, in which most of the Gnostic symbolism has undergone a transformation to suit the prevailing religious mood. As we said earlier, this was a salient feature which Waite failed to grasp—an opinion which is confirmed by the remarks of Jung[55]: "Undeniably, borrowings were made over and over again from the Church, but when we come to the original basic ideas of alchemy we find elements that derive from pagan, and more particularly from Gnostic, sources. The roots of Gnosticism do not lie in Christianity at all—it is far truer to say that Christianity was assimilated through Gnosticism".

The mechanism by which symbols were transferred from Gnostic to Christian usage is a subject for psychological study, but the origin of such symbols may be clearly seen—indeed, in many cases there is little apparent change in form.

"The One is the All"—the doctrine of the fundamental unity of all things—symbolized by the Gnostics as the Ouroboros, recurs constantly in this form, or as a dragon. To bring about its spiritualization, or transformation into *pneuma*, the dragon had to be slain; this is expressed quite clearly in the passage from Michael Maier quoted by Read[56]: "The Dragon . . . must be tamed with iron, with hunger, and with poison, until he swallows and vomits himself up again, kills himself, and bears himself". In every respect the analogy to the sacrificial ritual in the first vision of Zosimos is striking, down to the slaying by the sword and the vomiting of the self. The same ritual slaying is met with elsewhere; in some cases the symbol has become a lion which, after slaying, is dismembered by the severing of the paws[57].

This killing by means of the sword (the Ophitic "flaming sword") is splendidly featured in the Sixth Parable of *Splendor Solis*[58] (Plate I): "Rosinos relates of a vision he had of a man whose body was dead and yet beautiful and white like Salt. The Head had a fine Golden appearance, but was cut off the trunk, and so were all the limbs; next to him stood an ugly man of black and cruel

[55] Jung, *Psychology and Alchemy*, London, 1953, p. 343.

[56] J. Read, *Prelude to Chemistry*, London, 1936, p. 241.

[57] Jung, *Mysteries*, p. 298.

[58] *Splendor Solis*, Harley MS 3469 (Brit. Mus.); a version with explanatory notes by J. K. was published by Kegan Paul in 1921.

countenance, with a blood-stained double-edged sword in his right hand, and he was the good man's murderer. In his left hand was a paper on which the following was written: "I have killed thee, that thou mayest receive a super-abundant life, but thy head I will carefully hide, that the worldly wantons may not find thee, and destroy the earth, and the body I will bury, that it may putrefy, and grow and bear innumerable fruit".

The rich symbolism of Michael Maier in *Atalanta Fugiens*[59] illustrates the separative function of the sword in yet another way. The alchemist is revealed (Plate 2) wielding the fiery sword above the Philosopher's Egg: in Professor Read's quotation "He is adjured to aim at the egg "carefully, as is the custom, with the fiery sword; let Mars (iron) lend his aid to Vulcan (fire), and thence the chick (philosopher's stone) arising will be conqueror of iron and fire".

One further example from the vast repertoire will be quoted. In the parable from the *Tractatus Aureus*[60], the narrator describes how in his experiences he entered a small square garden, surrounded by a rose hedge. There came forward to meet him "the most beautiful of all the maidens", accompanied by her betrothed one. After an exchange of greetings the maiden took her departure, explaining that she and her "beloved bridegroom" were about to leave the garden and retire to their chamber "to satisfy our love".

The Gnostic analogy here is plain; among the Marcosians the receiving of the sacrament by a woman was symbolized as a mystical union, in which the recipient is likened to a bride. "Prepare thyself" said Marcos "as a bride who awaits her spouse, that thou mayest become what I am and I what thou art. Receive in thy nuptial chamber the seed of light . . ."[61]. The alchemical sense, of course, lies in the fusion of the male and female elements, sophic sulphur and sophic mercury, to form a unity. Again, this masculine—feminine conjunction recalls the marriage of the "faire White Woman" to the "Ruddy Man" in Thomas Norton's *Ordinall of Alchimy*[62].

Only a few examples of Gnostic persistence in late alchemical symbolism have been given. Many more could be found, but the above should suffice to

[59] *Vide* Read, *The Alchemist in Life, Literature and Art*, London, 1947, p. 21. (I am indebted to Professor John Read for permission to reproduce this plate; and to Messrs. G. Bell & Sons, Ltd., for kindly loaning the block.)

[60] *Tractatus Aureus de Lapide Philosophico* first appeared in *Musaeum Hermeticum*, published at Frankfurt in 1625; an English version by A. E. Waite appeared in 1893 and again in 1953 (reprint). The parable appears on p. 41 ff. of the latter.

[61] Leisegang, *op. cit.*, p. 234–5.

[62] Thomas Norton, *The Ordinall of Alchimy*, first printed in English in Ashmole's *Theatrum Chemicum Britannicum*, London, 1652, pp. 1–106. A facsimile reproduction, with introduction by E. J. Holmyard, was published at London in 1928.

show that the main source from which alchemical mysticism derived was Gnosticism—that, as Berthelot[63] observed, "il existait dès l'origine une affinité secrète entre la Gnose, qui enseigne le sens véritable des théories philosophiques et religieuses, dissimulées sous le voile des symboles et des allégories, et la Chimie, qui poursuit la connaissance des propriétés cachées de la nature, et qui les représente, même de nos jours, par des signes à double et triple sens".

[63] Berthelot, *Origines*, p. 66.

SOME INDICATIONS OF NEWTON'S ATTITUDE TOWARDS ALCHEMY

By D. Geoghegan

In 1669, and shortly before succeeding Isaac Barrow as Lucasian Professor of Mathematics, an early recorded indication of Newton's interest in alchemy is shown by the following extracts from a letter, dated 18 May, 1669, that he wrote to his friend Francis Aston who was then "entering upon his travels":

> . . . Observe the products of nature in several places, especially in mines, with the circumstances of mining, and of extracting metals or minerals out of their oare, and of refining them; and if you meet with any transmutations out of their own species into another, (as out of iron into copper, out of any metall into quicksilver, out of one salt into another, or into an insipid body, &c.) those, above all, will be worth your noting, being the most luciferous, and many times lucriferous experiments too in Philosophy . . . .
>
> . . . There is in Holland one —— Borry, who some years since was imprisoned by the Pope, to have extorted from him secrets (as I am told) of great worth, both as to medicine and profit, but he escaped into Holland, where they have granted him a guard. I think he usually goes cloathed in green. Pray inquire what you can of him, and whether his ingenuity be any profit to the Dutch . . .[1]

Undoubtedly the "one —— Borry" mentioned in this letter refers to Gioseppe Francesco Borri, who had made himself notorious as a self-styled alchemist and mystic[2].

In later years, Newton seems to have been particularly interested in the experiments with gold and mercury that Boyle had discussed in his paper on *An Experimental Discourse of Quicksilver growing hot with Gold*[3]. These experiments are said to have been made with a specially refined mercury

[1] *Cf. Biographia Britannica*, London, 1747–66, Vol. V, pp. 3241–2.

[2] For an account of this extraordinary personage *vide* Bayle's *Historical and Critical Dictionary*, London, 1735, Vol. II, p. 84; and Ferguson, *Bibliotheca Chemica*, Glasgow, 1906, Vol. I, p. 117.

[3] *Cf.* Boyle's *Works*, London, 1744, Vol. III, p. 558. Boyle's introductory remarks are interesting: ". . . And I have the less wondered to find many learned men so averse from believing this incalescence of mercury and gold, because, having purposely inquired of several prying alchemists that have spent much labour and many trials to find out things of this kind, and have of late years travelled into many parts of *Europe*, to pry into the secrets of other seekers of metalline transmutations, they . . . confessed to me that they never actually saw any incalescent mercury, though they sometimes heard it boasted by all alchemists . . ."

which Boyle had previously obtained in 1652. Newton must have considered that such researches were of great alchemical significance for, in writing to Henry Oldenburgh on 26 April, 1676, he says:

> . . . Yesterday I reading the two last *Philosophical Transactions* had the opportunity to consider Mr. *Boyle's* uncommon experiment about the *incalescence of gold and mercury*. I believe the fingers of many will itch to be at the knowledge of the preparation of such a mercury . . . But yet because the way by which ☿ may be so impregnated, has been thought fit to be concealed by others, that have known it, and therefore may possibly be an inlet to something more noble, not to be communicated without immense damage to the world, if there should be any verity in the Hermetic writers; therefore I question not, but that the great wisdom of the noble author will sway him to high silence, till he shall be resolved of what consequence the thing may be, either by his own experience, or the judgment of some other, that thoroughly understands what he speaks about; that is, of a true Hermetic philosopher whose judgment (if there be any such) would be more to be regarded in this point, than that of all the world beside to the contrary, there being other things beside the *transmutation of metals*, (if those great pretenders brag not) which none but they understand. Sir, because the author seems desirous of the sense of others in this point, I have been so free as to shoot my bolt; but pray keep this letter private to yourself[4].

It is evident that Newton did not wish his own opinions on alchemy to be published, and this accords with his known habit of refraining from forming a judgment that was not grounded either on mathematical or experimental proof. His attitude towards alchemy appears to have been fundamentally *en rapport* with alchemical concepts; and he maintained a balanced outlook on the possibility of substantiating the Hermetic claims of transmutation in accordance with his own attempted interpretation of the esoteric processes. That his interest in Boyle's experiments continued unabated for several years is revealed by his correspondence with Locke, to whom he wrote, on 26 January, 1691–2, and added in a postscript:

> I understand Mr. Boyle communicated his process about the red earth and Mercury to you as well as to me, and, before his death, procured some of that earth for his friends[5].

And again, on 16 February, 1691/2:

> . . . Mr. Pawling told me, you had writ for some of Mr. Boyle's red earth, and by that I knew you had the receipt[6].

[4] Cited in Boyle, *op. cit.*, Vol. I, p. 65.

[5] Cited in King's *Life of John Locke*, London, 1830, Vol. I, p. 408.

[6] It might be surmised that this "red earth" consisted of an impure gold in a very fine powder.

In the first of two subsequent letters to Locke, dated 7 July and 2 August, 1692, respectively, Newton acknowledges the receipt of a sample of this earth, "much more", he says, "than I expected. For I desired only a specimen, having no inclination to prosecute the process. For, in good earnest, I have no opinion of it". He concludes by admitting that he has "lost the first and third part [of the recipe] out of my pocket". And he mentions in a postscript that: "When the hot weather is over, I intend to try the beginning tho' the success seem improbable".

But apparently Newton had later been informed that all the relevant details of this process were in Locke's possession for, in his following letter (of 2 August, 1692), he remarks:

> . . . I am glad you have all the three parts of the recipe entire; but before you go to work about it, I desire you would consider these things, for it may perhaps save you time and expense. This recipe I take to be the thing for the sake of which Mr. Boyle procured the repeal of the Act of Parliament against Multipliers, and therefore he had it then in his hands[7]. In the margin of the recipe was noted, that the mercury of the first work would grow hot with gold, and thence I gather that this recipe was the foundation of what he published many years ago, about such mercuries as would grow hot with gold, and therefore was then known to him, that is, sixteen or twenty years ago, at least; and yet in all this time I cannot find that he has either tried it himself, or got it tried with success by anybody else . . .[8].

From the remainder of this letter it is manifested that Newton did not doubt that "mercury, by this recipe, may be brought to change its colours and properties, but not that gold may be multiplied thereby". And this latter opinion was strengthened by his information regarding the failure of "a company who were upon this work in London". But he also believed that Boyle had withheld a part of the recipe, and without these details he could not make a trial. Nevertheless, he did intend "only to try whether I know enough to make a mercury which will grow hot with gold". He inquired whether Locke had "any thing more than is written down in the three parts of the recipe"; and he concluded by saying: "In dissuading you from too hasty a trial of this recipe, I have forborne to say any thing against multiplication in general, because you seem persuaded of it; though there is one argument against it, which I could never find an answer to, . . .".

In 1696, Newton received a visit from "a Londoner" with whom he discussed a particular alchemical process involving, among other constituents, the use of vitriol. He duly recorded the occasion of this visit, and he added some

[7] Possibly this recipe was in the "collection of chemical processes" which could not be found after his death. *Cf.* Boyle, *ibid.*, p. 82.

[8] King, *op. cit.*, p. 410.

notes as an *aide-mémoire* of the conversation. These notes (of which a transcript will now be given[9]) afford us an additional glimpse of Newton's attitude towards alchemy and his continued interest in alchemical experimentation at a period that was only a few days in advance of his appointment as Warden of the Mint[10].

Transcript

On Munday March 2^{d} or Tuesday March 3 1695/6, A Londoner acquainted wth Mr Boyle & Dr Dickinson making me a visit, affirmed that in the work of Jodochus a Rhe wth ♁ twas not necessary that the ♁ should be purified but the oyle or spirit might be taken as sold in shops wthout so much as rectifying it. That the fire does not destroy the life of the Oyle or Spirit in distilling it from the red hot vitriol. That two or three pounds of Oyle or spirit will not afford above half an ounce of fixt salt & that that y^{e} oyle affords more fixt salt then the spirit. That the white spirit is in appearance like rain water only sweet & fragrant, & that Dr Twisdens spirit as I described it to him was genuine. That the white spirit must be rectified seven times from its faex without separating any flegm from it, & that in rectifying, it will endure any heat without losing its life. That the remaining matter for extracting the soul must not be calcined to a red heat, but only well dryed, least the soul fly away. That for extracting the soul the spirit must be digested on this matter not two months but only till it appear well coloured with the extracted soul. That when you draw off the spirit from the soul you must leave the soul not thick like honey or butter but thinner then oyle so that you may pour clean out of your glass like a liquor & that it will keep better in moisture then when too dry & therefore tis safest to err on that hand there being no danger in keeping it too moist. I think he said also that the soul must be volatized by the spirit, but I'm sure tis so in y^{e} Process of Jodochus p 20 & those of Basilius wth ☉ & other metalls Key 5 p 22. Test. p 123 lin 5 & p 154 l 17, 18, 19, 20 & p 166 lin ult & p 169, l 19, 20, 21 & p 170 l 19, 20, 21, 22. Et Snyders Pharm. Cath. p. 15 l ult & p 21 l 25.

He told me also that when all the soul is extracted the remaining matter must be put in a crucible covered wth a muffle or hollow cap of iron like a bowl inverted and a fire made round about them for an hour w^{ch} cannot easily be too hot. Then y^{e} salt extracted wth y^{e} spirit & the matter calcined again and extracted as before & so on till no more salt can be extracted. That he imbibed this fixt salt always wth 1/8th part of the spirit [perhaps 8, 10, or 12

[9] I am indebted to the Provost and Fellows of King's College, Cambridge, for permission to publish this transcript of Keynes MS. 26.

[10] The notice of this appointment was conveyed to him in a letter from Charles Montague, dated 19 March, 1695/6. *Cf.* Brewster's *Life of Sir Isaac Newton*, London, 1861, p. 248.

times] & that when it was so long imbibed till it became volatile it was not necessary to sublime it. ffor all is pure, & if in the sublimation any thing should remain below, that would not be a heterogeneous impurity to be rejected but an unripe part of the matter w^{ch} by further imbibition would be all ripened & volatized like the rest. And that if in imbibing you should at any time use too great heat, all the hurt would be only the loss of so much matter as sublimes & dries upon y^{e} upper part of y^{e} vessel. And that in every imbibition he let y^{e} matter imbibed wth 1/8 of y^{e} spirit continue in y^{e} cold for 3 days the better to unite them, and then digested them 4 or 5 days more. And when he had finished y^{e} work wth y^{e} white spirit he imbibed in like manner wth an eighth part of the red soule [perhaps 7 times]. And that when y^{e} 3 principles were joyned the menstruum becomes a notable one. It then dissolves and volatizes all metals & Gold dissolved & volatized may be digested with it to the end.

When he had finished the imbibitions whether with both y^{e} white & red spirits, or rather wth y^{e} white alone, he said that the matter flowed wth an easy heat but in cold congealed & grew hard like a stone, & by digestion passed through y^{e} colours black white citrine & red & in the beginning of the decoction it fumed up like a cloud as is described in the process of Jod. Rhe. And that in this decoction if the fire should go out for a while the matter would not thereby lose its life or motion but go on still when y^{e} fire is kindled anew. And that it never putrefied but in the first decoction. Whence I seem to gather that he putrefied wth y^{e} white spirit alone & multiplied only by imbibing wth the red as is described by Jodocus & Basil. This work he fermented by melting wth ☉ & said that the whole was finished in 9 months.

LETTERS TO THE EDITOR

THE SYMBOLIC MEANING OF FAHRENHEIT'S TEMPERATURE SCALE

Sir,—Although Fahrenheit's thermometric scale has been extensively utilized for nearly two and a half centuries, it's "arbitrariness" may appear singularly manifest to those who are accustomed to the Centigrade system. The "arbitrariness" of Fahrenheit's scale has induced me to analyse this system for any esoteric meaning that it might conceal. The results of my numerical analyses are presented in the following paragraphs.

Degrees Fahrenheit		Diagonal Sum of Numbers on left
Boiling Point of Water	212	5
Divisions between B.P. and F.P. ..	180	9
Freezing Point of Water	32	5
	Total	19 1 (0)

The numbers thus obtained on the right side read in sequence:

595 191

The sublety and symmetry of this numerical configuration suggest a coded message, which I have endeavoured to interpret in accordance with cabalistic precepts. Accordingly, the number 5 represents man. Its meaning derives from the symmetry of the human body (five fingers on each hand; five extremities, if the head is counted as one; and five openings of the face). The number 9, which is the highest one obtainable through diagonal sums, represents achievement, power, or perfection. The above formula might, on these terms, be interpreted as follows:

5 9 5 .. .. 1 9 1

"The achievement of man equals the perfection of God's Works."

Alternatively, this formula might be taken as indicating that "Our (5) perfect (9) quintessence (5) equals (or is the same as) the *prima materia* (1) that God (9) created in the beginning (1)".

Both these dicta express the alchemical concepts that continued to be manifested, until the late 18th century, either in the thinly disguised pursuit of the all-powerful philosopher's stone, or as attempts at the "synthesis" of the homunculus.

The formula obtained from Fahrenheit's thermometer scale will, when further treated by the diagonal sum system, yield the following sub-formulae:

(*a*) 595 191
(*b*) 19 (+) 11 (=30)
(*c*) 1 (0) 2 3 (0)

Formula (*b*): two prime numbers "complement" each other by yielding 30. Thirty, an even and highly divisible number, suggests the Platonic concept of harmonization of two disharmonious elements (male and female) through unification. This formulation may relate to the alchemists' theories concerning "masculine" and "feminine" elements and their "alchemical marriages" (compound formations).

Formula (*c*): the philosophical and theological implications of the numbers 1, 2 and 3 could—and do—fill many volumes.

Fahrenheit claimed to have based the zero point of his scale on the temperature of a mixture of salt and ice. This information, however, is experimentally worthless, as the proportions of this mixture remain unknown. Hence, I am inclined to consider this datum as a blind lead, calculated to detract popular attention from the "secret". The need for secrecy is not apparent, unless one assumes that Fahrenheit was bound by some sort of oath. It is, therefore suggested that Fahrenheit may have been a member of an alchemical fraternity —possibly the Rosenkreutzers—and that he endeavoured, in this novel manner, to transmit "classified information" to his fellow adepts.

I shall be interested to know whether readers of AMBIX agree with the matters discussed in this letter.

I am, Sir, etc.,

Leontine Goldschmidt.

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REVIEWS

Forgerons et Alchimistes. By MIRCEA ELIADE. Pp. 211. 8 plates. Paris: Flammarion, 1956.

IN this remarkable book Professor Eliade strips the alchemical myth of its literary embellishments and takes us to the origins, to the world of archaic man. We find that the miner, the smith, the worker in metals in their relation to their respective crafts were dominated by a complex system of rituals always leading to an "initiation", whose purpose is what might be termed the "redemption of matter". Matter can only be dominated by an "initiated person", it can only be transformed and changed into useful objects without upsetting the order of the cosmos if the smith, for instance, assumes the position of the Divine Creator, if he greatly accelerates the process of nature—nature, broadly speaking, is regarded as the cosmic matrix—by means of his craft, and these secrets can only be acquired by undergoing a long and arduous training. The smith, as an initiate, is allowed to dominate matter, he has taken the place of the god. From the transformation of metals for the purposes of daily life it is only a step to the experimenting with further possibilities of transformation, with the "initiation" of matter itself, that is with the transforming of metal into its highest and most perfect condition, just as the initiated craftsman reaches a kind of perfection on the human level. The relation between the initiate-craftsman and the "sacralité de la matière" is never broken; as Professor Jung rightly stresses, there is a close relation between the alchemist and the process of obtaining the Stone, there are two parallel and interchangeable processes leading to perfection, dominated by the "initiate", the alchemist: one is the redemption or sublimation of the alchemist himself; the other, the redemption of matter through him, which reflects externally his own subjective transformation.

In the world of archaic man we have a whole mythology: iron, the "sex of minerals", the metallurgic rites and mysteries, the *petra genetrix*, the all-important role of fire, in its many aspects, the triangle, and especially the "mystic participation" of archaic man with nature, a participation based on a profound feeling of reverence which is difficult for members of later utilitarian civilizations to comprehend. The cosmological symbolism of archaic man gave him a particular experience of the world, far removed from any modern counterpart[1]. We can to a great extent recover the sequence of events in this archaic experience of life, but we have not the key to the understanding of the secret, we do not know the "formulae" that were necessary for evolving a life of participation with nature dominated by the craftsman-initiate. Of the initiation of the latter we have completely lost the secret, but we have rediscovered the path leading to it, and this discovery we can rightly attribute to modern psychological and anthropological research, unsystematic and subjective as this type of research may often be. The open door to the world

[1] See also Professor Eliade's article in the *Etudes Carmélitaines*, 1954, entitled "Expérience Sensorielle et Expérience Mystique Chez les Primitifs".

of archaic man is the vast compendium of alchemical symbolism; the latter when understood and properly evaluated will be seen to have its roots completely in that world from which it took its component parts. From this point of view—as an aid to the understanding of what alchemy is trying to achieve, why it has survived, at least as a scholarly problem, and what value there may be in the alchemical way of life for the future—Professor Eliade's book is invaluable. Alchemy is shown to be a way of initiation, a way of freedom from the domination of matter. This view is also expounded by Professor Eliade in a chapter on alchemy in his book on "Yoga"; that one chapter contains a great deal of sound information about the subject and may be said to complement this present book.

In the chapter on "Alchimie et Initiation" of the book under review, Professor Eliade tells how the ancient belief in the Earth-Mother as a carrier of mineral-embryos crystallized into a belief in artificial transmutation. The drama of the "suffering" of matter, of its "death" and its "resurrection" is already depicted in Graeco-Egyptian alchemy. The dream of Zosimos corresponds in detail with the initiate-visions of archaic times[2]. The great innovation of the alchemists is that they have projected on to matter the initiation function of suffering. Gold is the symbol of immortality; in Egypt the flesh of gods was gold, and by eating it the Pharaoh himself obtained a golden body. The alchemical transmutation is equivalent to the perfection of matter, or, in Christian terminology, to its redemption. An interesting detail here is a discussion of the "torture" of metals, as clearly mentioned in the "Turba". "Torture" always leads to "death", to *mortificatio*, *putrefactio*, *nigredo*—there is no possibility of "resurrection" to a transcendant state without first the experience of "death". In the chapter "Arcana Artis" Professor Eliade further shows how the *opus alchymicum* is perhaps not a continuation, in the strict sense of the word, of the metallurgic path of initiation of archaic man—continuation need not mean identity—but it follows the same pattern exactly, it uses the same "technique mystique", it describes the same "terrible experiences" of the novice, the whole "sequence of the steps of initiation" is exactly the same. The tendency of the modern reader of alchemical texts to look upon them as a purely scholarly problem, or as the sources of hidden knowledge that can improve one's way of life, is beside the point. In alchemy we have the archaic world still with us, and this world can teach us much. Professor Eliade in a masterly fashion discusses the archaic point of view as contrasted with modern man and his seemingly insoluble problems. The alchemist is the substitution for the time factor; that is, he, by his art, can accelerate greatly the gestation of metals and minerals in the earth womb; he can transform and perfect them. Modern man has become the time-substitute in the wrong sense: what to do with time is the fateful problem today. Work has become secularized, whereas in archaic times it was "sacralisé".

In the chapter on Chinese alchemy Professor Eliade shows how during the neo-Taoist epoch the alchemist endeavoured to rediscover the "ancient wisdom". To use modern terms, the "intelligentia" concentrated their interest on a tradition that still survived orally and it was the task of the Taoist masters to interpret this tradition: the alchemical furnace was the descendant of the forge of archaic times and the production of the "divine cinnabar", which

[2] Eliade: *Le Chamanisme*. Paris, Payot, 1951.

gave immortality to the "master", had its origin in the melting down of a magical utensil together with an appropriate sacrifice on the part of the smith-initiate, who thereby hoped to gain eternal life. The Chinese Taoists, more than their alchemical counterparts in other countries, helped to prolong a tradition that was beyond time, and that is why Chinese alchemy is so important from the point of view of uncovering the archaic origins of alchemy itself. The three elements that belong to the cultural heritage of proto-history—the traditional cosmological principles; the myths that are related to the idea of the elixir of immortality and the Immortals of the Taoist legend; and the technique of acquiring long life, beatitude and spiritual spontaneity—are strongly emphasized in Chinese alchemy. After a while, the Chinese masters began to distinguish between exoteric and esoteric alchemy, the former having to do with concrete substances, whereas the latter only working on the "souls" of these substances. From here it was a logical step to the development of a "technique" of asceticism and contemplation, which led to the schools of Zen Buddhism, where the great Po Yü-chuan formulated esoteric alchemy as follows: there are three methods which constitute esoteric alchemy and which are necessary in order to achieve the desired result. In the first method the body fulfils the role of the element lead and the heart the role of mercury; meditation (dhyana) furnishes the liquid necessary for the alchemical operation; the sparks of intelligence furnish the fire. "By this method a gestation which usually takes ten months can be consummated in the twinkling of an eye". In other words, the analogy between the giving birth of a child and the producing of the Stone is evident; indeed, many European texts mention the fire in the athanor which must burn forty weeks. In the second method a psychological and psychic method is applied; the breath takes the place of the element lead and the soul that of the element mercury, breathing and psychic "states", retention of breath and control and immobilization of the psycho-mental flux are a part of this alchemical yoga. Finally, in the third method the human sperm corresponds to lead and the blood to mercury, the loins to water and the spirit to the element fire. Here we approach the Yogic-Tantric practices of India, which are discussed in the interesting chapter on Indian alchemy[3].

Writing about the methods of alchemy described by European authors, and hinting in obscure phrases at the secrets which must not be divulged, has been a literary exercise for several centuries, and has been completely misleading. It would be invidious to mention the many excellent historians who have enriched our knowledge of alchemy: in Professor Eliade we have a scholar whose penetrating and inclusive scholarship has redeemed the literary errors of the past. G. H.

A History of Industrial Chemistry. By F. Sherwood Taylor. Pp. xvi, 467. 22 plates and 62 figs. London: Heinemann, 1957. Price 30s.

In chemistry, as with other branches of science, the best guide to progress is a knowledge of the past; and in the late Dr. Sherwood Taylor's book—which was seen through the press by Mr. F. Greenaway—we have an eminently

[3] Eliade: *Le Yoga*. Paris, Payot, 1954. (English translation published by Messrs. Kegan Paul.)

readable and informative survey of the history of industrial chemistry. It is a *tour de force* to have succeeded in such a task, for here we are given a well-woven narrative that depicts the progress of technology from the earliest times to the discovery of nuclear fission. In order to avoid any misapprehension in his treatment of the subject, the term "industrial chemistry" has been interpreted: "in a very wide sense, so as to include all modifications of the composition of matter that have been undertaken for profit or use, even though they may not in earlier times been recognized as belonging to chemistry nor yet have been carried out on what we to-day regard as an industrial scale". This definition is an important prelude to the scope of the book, because it is only by examining certain aspects of alchemical activity that the history of chemistry can be unfolded, and the subsequent industrial applications visualized as evolving from empirical into scientific methods of research.

Dr. Taylor has divided his main text into two parts dealing, respectively, with the pre-scientific and scientific chemical industries. He begins with a résumé of the principal cultures that have contributed to chemical technique; and Part I is preceded by an introductory chapter of particular interest to the general reader. In the 143 pages comprising chapters II-XII of Part I, we have a succinct account concerning the powers and limitations of the ancient crafts and techniques on the subjects of metallurgy, cements, ceramics, pigments, mineral acids, combustibles, dyeing, cleansing, pharmacy, and fermentation. This discourse is attractively presented in a manner imbued with the spirit of the humanities. The reader's interest is also enhanced by the inclusion of several citations from various sources (sometimes not fully documented), such as Sir John Pettus' description of a lead mine (originally published in his *Fleta Minor*, 1683, pp. 82-83); and a recipe, taken from Russell's translation of Geber's *Works* (1678, p. 269), that indicates the first known preparation of a mineral acid.

In chapter X, Dr. Taylor quotes from a hitherto unpublished manuscript book of recipes collected by the physician Theodore Turquet de Mayerne (1573-1655) and "Jo. Colladon" (*sic.*). The recipe, in question, is said to contain the first record of the salting-out process used in soap manufacture. "Jo. Colladon" has not been identified: was he, perhaps, the "Sir John Collaton" —there are variant spellings, e.g. "Collidon"—mentioned by Pepys as having been an associate of Sir Edward Ford, the royalist soldier and inventor?

The numerous illustrations that entertain the reader in this section of the book, include those of an Egyptian glass alembic, a Catalan furnace, (from a drawing by Leonardo da Vinci), and the ingenious pneumatic apparatus used by Sir Humphry Davy for measuring the "carbonic acid gas" obtained in his method of determining the limestone content of soils.

It was not until the beginning of the nineteenth century that the effect of the chemical revolution, initiated by Lavoisier in 1788, began to point the way towards a scientific control of processes which had hitherto been based upon purely empirical methods of experimentation. In Part II, Dr. Taylor opens his history of the scientific chemical industries with a preliminary review of the problems besetting the gradual transition from craft to science. He outlines the development of theories that culminated in the establishment of quantitative analysis; and he proceeds to discuss the rise of scientific chemical industry, 1788-1860. This is an important period in the history of industrial inorganic chemistry, and we are given an interesting sketch of the alkali, glass,

ferrous, non-ferrous, phosphorus, and coal-gas industries. Occasional references to the early history of relevant subjects, previously discussed in Part I, help us to remember that the principal *motif* in the history of chemistry is its transformation from an art into a science. The longest chapter in this section of the book, deals with industrial organic chemistry; and here the limitations of printing space are used to the best possible advantage in delineating the many practical applications of organic research. There are chapters on theoretical inorganic and organic chemistry, the discovery of the chemical elements, chemical theory, the road to nuclear power, the arrangement of molecules, the electro-chemical industries, the conditions of chemical reactions, and finally, on industrial gas-reactions. There is a good index, and a useful bibliography.

Dr. Taylor's treatment of the physico-chemical considerations involved in these chapters is a model of expository clarity; and the large number of illustrations are an attractive feature of a book which will undoubtedly be widely read with much pleasure and profit. D. G.

Les Clefs de la Philosophie Spagyrique. By Le Breton. Texte conforme à l'édition de 1722 publiée chez Claude Jombert, rue Saint-Jacques, à Paris. Introduction de René Alleau. Caractères "Collection Quintessences". Paris, 1957.

The title of this book is slightly misleading: the term "Spagyrique" is here used in its wider sense, as meaning alchemy in its entirety. As an introduction to the subject, written by an author who professed to have followed the alchemical way of life, it is one of the best works available. The style is very lucid and in the description of the process of attaining the Hermetic goal the author is more explicit than most alchemical writers. The sixth section, "De l'Union" is particularly interesting; in a condensed form is given the account of the metaphysical progression of the most important stage of the alchemical process.

The book is divided into seven sections: calcination, putrefaction, solution, distillation, sublimation, union and coagulation, followed by a long section on "de l'Elixir Mineral". The author uses aphorisms throughout the book.

In the interesting and learned preface Monsieur Alleau has gathered together all the facts about the life of Le Breton that are available. Mention is made of a literary curiosity: viz., the article, celebrated in its day, by Etienne François Geoffroy and published in the "Mémoires de l'Académie" entitled "Des supercheries concernant la pierre philosophale" in which Geoffroy does not condemn the principles of alchemy but criticizes the juggleries of the "souffleurs". Monsieur Alleau ends his preface by giving us his own very penetrating views of our subject. G. H.

Chymia Perennis. Eine ganzheitliche Betrachtung naturphilosophischer Prägung des stetig-ständigen Kreislaufes einer "immerwährenden Chemie". By W. Walter Meissner. Deutscher Heimat-Verlag Bielefeld-Bethel. 1956. Pp. 1012.

The German language lends itself to an agglutination of concepts and of words, both of which can then be classified, subdivided and re-classified both horizontally and vertically with the result that you have produced a book.

That is the trouble here: the author sets out to give the reader a kind of metaphysical history of the idea of chemistry, which includes alchemy (pp. 446–546) and iatrochemistry (pp. 547–610). Some of his personally coined terms are "Chemogenese", that is to say "Chymia Perennis as a concept"; "Chemopsychogenese", which means "Chymia Perennis as spiritual becoming"; and on p. 270, Part III, section 1, subsection I we have "Irdisches Urwerden". But it would be unjust to over-emphasize the "metaphysical" aspect of this book. The author is a trained chemist and there is an immense amount of very interesting material here, condensed in spite of a mass of irrelevant subject-matter. The author's ambition is to put into one volume the conditions that produced the ideas that led to concepts which we classify as chemistry, alchemy, phlogiston, and so on. The author is "darwinian" in his outlook as to the origin of the human race; on p. 616 his paragraph on "Christentum und Aufklärung" is naïve; in fact, the latest opinions such as we take for granted in Western Europe are not included in the conclusions of the author. The chief value of this book lies in its outstanding usefulness as a work of reference for the historian of science; there many subjects are discussed that can only be found in old and scarce books. There are five excellent indexes. G. H.

Canto della Montagna. By "Anonimo" (Scuola di Paracelso) Fussi Firenze, a cura di Guido Manacorda. 1957. Pp. 77. 2 plates.

This alchemical poem, written in early seventeenth-century German, was first described in 1907 in the "Rivista di Letteratura tedesca". The manuscript was discovered in the public library in Catania; the author, a follower of Paracelsus, is unknown.

This attractive little book contains the whole poem with a parallel Italian translation, preceded by a scholarly introduction by the translator, and the text is followed by his very inclusive notes. The text comprises the poem and a letter by Paracelsus to a noble friend, giving directions for making the Tincture. This letter is also translated.

The author of the poem in a short prose preface tells how he sought in vain for a long time but at last discovered in some manuscripts the secret of the "manipulation". As he does not wish this secret to be lost, he sets out and writes this poem. The manufacture of the Stone is described in symbolical language that refers constantly to the metals in terms of their planetary significance. At the right of the German text, on the same page, the explanation of the symbols is always given. Paracelsus is mentioned sixteen times and it would be correct to say that the arrangement of the different stages of the "process" is made according to the progression used by Paracelsus in his "Thesaurum Alchimistarum" and his "Buch von Mineralien". The Italian translation is excellent. G. H.

Beiträge zur Geschichte der Technologie und der Alchimie. By W. Ganzenmüller. Verlag Chemie. GMBH. Weinheim/Bergstr. 1956. With 26 illustrations. Pp. 389.

This book contains the author's collected articles, of which many, especially for the English reader, have been inaccessible because they have been published in specialized technical journals.

In the first half of the book there are seventeen articles on the history of glassmaking. For the student of alchemy the two articles on Kunckel and the one entitled "Beiträge zur Geschichte des Goldrubinglases" are of interest.

The remainder of the book deals with the historical aspect of alchemy and these articles are proof of sound scholarship and an unusually wide range of association in the field of mediaeval alchemy. The author, however, does not limit himself to a merely academic interpretation of the subject: he is well aware of the more recent trends, such as the ideas of Professors Jung and Hartlaub and the books by Peuckert. He also discusses a plan for organizing the future study of alchemy with characteristic Teutonic thoroughness; fortunately it is too late for this plan ever to develop, which would take every bit of enthusiasm out of any interest in the study of alchemy and leave the arena to the academic hireling, and not to the scholar.

Many of the articles contain new and unusual material. "Der Schutzpatron der Alchimisten", "Das Buch der heiligen Dreifaltigkeit"—the description of a very interesting German alchemical manuscript, copies of which were known only to collectors—"Liber Florum Geberti" and "Quellen zur Geschichte der Chemie in süddeutschen und ostmärkischen Bibliotheken" deserve praise as works of a high standard of scholarship.

Altogether a remarkable book that must not be missed by the historian of science or by the historian of ideas. G. H.

Through Alchemy to Chemistry. By John Read. Pp. xvii, 206. Numerous illustrations. London, G. Bell, 1957. Price 18s. 6d.

In this book—which is particularly appropriate for the general reader—the author, as he states in his preface, continues a central theme of his three earlier volumes, *Prelude to Chemistry, The Alchemist in Life, Literature and Art,* and *Humour and Humanism in Chemistry*. It is regrettable that only the last of this trilogy is still in print though, as would be expected, Professor Read has not hesitated to draw from them in connexion with his present text. In the first eight chapters, the principal concepts of alchemy are outlined and discussed in their developing aspects through successive epochs, until their final overthrow in the second half of the eighteenth century. It is difficult to postulate a comprehensive definition of alchemy, but we may infer that it was a theoretical and practical evolution of *a priori* cosmologistic concepts, which latter were retained as a background in the presentation of alchemistic philosophy up to the time of Lavoisier. By bringing this background into sharp relief with the aid of extracts from early texts and other helpful adjuncts, Professor Read has produced a composite picture of his central theme.

Chapter 9 deals with the development of modern chemistry, and here Dalton's atomic theory is sketched in its due perspective; it is followed by an account of Mendeléeff's Periodic System, and of the pioneer work of Thomson and Rutherford on atomic structure.

The final chapter contains a short discourse on the rise of organic chemistry, with emphasis on molecular structure and isomerism, while the alchemical *motif* is sustained by an apposite comparison of Kekulé's benzene ring formulation with the imagery of the Ouroboros serpent.

Among the numerous and attractive illustrations in this well-written and well-produced little book, we may note that one plate (Fig. 23), which depicts Sendivogius making gold, has been reproduced from a photograph presented by the late Professor Tadeusz Estreicher, of Cracow. D. G.

Torbern Bergman: A Bibliography of his Works. Compiled by Birgitta Moström. Pp. 120, 3 plates. Stockholm: Almqvist and Wiksell, 1957. Price: Sw. cr. 24.

TORBERN BERGMAN was one of the most versatile of 18th century chemists, but much of his work has been neglected, probably because he played only a small part in the great drama of the rise and fall of the phlogiston theory, which has attracted the attention of so many critics.

In this bibliography, which contains more than 300 items, Birgitta Moström has listed in chronological order Bergman's many separate publications and contributions to periodicals, together with their reprints and translations. The introduction and notes are in English, and the value of the bibliography is enhanced by the cross-references and the index, in which the items are set out according to language and subject. Many of the works described are very rare, and it would have been helpful if their locations had been disclosed; in the introduction it is stated that some are in the possession of the Sveriges Vattenfabrikanters Riksförbund, Stockholm (with whose co-operation the bibliography has been published), but these works are not named.

Bergman's first publication appeared in 1755, and for several years his interests included mathematics, electricity, meteorology and natural history. After occupying the chairs of natural history and mathematics in the University of Uppsala, he became professor of chemistry in 1767, and from then until his death in 1784 he devoted most of his time to chemistry.

In 1773 he published a study of "aerial acid" (carbon dioxide), and an enlarged account of its preparation and properties, which appeared two years later, made his name famous. He was also interested at this time in the analysis of minerals and mineral waters, and helped to speed the advance of this important branch of chemistry by publishing full descriptions of his experimental methods. The results of his analyses were incorporated in his *Sciagraphia regni mineralis* (1782), a very useful textbook in which minerals were classified according to chemical composition. Bergman possessed a vast knowledge of the reactions of most of the known substances, and he systematised this knowledge in his great dissertation on elective attractions (1775, revised 1783), one of the most important studies of chemical affinity to be published in the 18th century.

The first volume of Bergman's collected works appeared in 1779, and the last in 1790, six years after his death. This edition was published in Latin, for Bergman, who contributed to the reform of chemical nomenclature, believed that the results of scientific work should be written in a language that was universally acceptable. But the day was already past when Latin was understood by all who were interested in science; all six volumes were at once translated into German, and the early volumes, containing the most important chemical memoirs, into English, French, Italian and Spanish.

These translations, and the many translations of his individual works, testify to Bergman's great influence during and immediately after his lifetime. It is to be hoped that the appearance of this admirable bibliography will stimulate renewed interest in the work of the great Swedish chemist.

W. A. S.

Ambix

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BOERHAAVE'S CHEMICAL WRITINGS

By F. W. Gibbs*

While lecturer and professor in the University of Leyden, Herman Boerhaave (1668–1738) taught medical subjects from 1701 to 1738, botany from 1709 to 1729 and chemistry from 1702 to 1729. His *Elementa Chemiae*, intended as an introductory textbook for the use primarily of medical students, has become one of the famous texts in chemical history. This is well shown by Professor John Read in his *Humour and Humanism in Chemistry* and elsewhere.

In view of what has already been written about the book, it may be thought that a further bibliographical study needs some justification. It is nearly forty years since Paul Diergart's informative article was published[1] and nearly thirty since those of Tenney L. Davis and Max Speter appeared[2]. Apparently Menno Hertzberger's catalogue[3], the most complete at that time, was not

* Royal Institute of Chemistry, London.

[1] P. Diergart, *Z. angew. Chem.*, 1919, **32** (1), 58.

[2] T. L. Davis, *Isis*, 1928, **10**, 33. Max Speter, in G. Bugge, *Das Buch der Grossen Chemiker*, Berlin, 1929, i, 216 etc.

[3] Menno Hertzberger, *Short-title Catalogue of books written and edited by Herman Boerhaave*, Amsterdam, 1927. Based on works in the library of the Royal Dutch Medical Association, Amsterdam, which forms part of the Amsterdam University Library.

available to Davis when his paper was written. Since then little new information has been given, and Hertzberger was unable to complete the full bibliography of Boerhaave's works that had been intended. None of these attempted to do much more, from the bibliographical point of view, than enumerate various editions of Boerhaave's genuine and supposititious works; they did not, for example, inquire into whether the various editions reported at different times did in fact exist, as distinct from listing editions actually known. The bibliography therefore remains less certain than need be.

There were two volumes of Boerhaave's *Elementa Chemiae*, the first dealing with theory, the second with practical procedures and discussions upon them. Historians generally have been interested only, or very largely, in the theory. This is unfortunate for, as the work was intended for "novices" and was widely used as a textbook for training chemists, the second volume was also important. Some editions of the work consisted of the theory only, some others of the practice only except for the addition of information about heat, furnaces and thermometers.

Further, there has been a tendency to date Boerhaave's influence in chemistry from 1732, the date of the genuine *Elementa Chemiae*, although he had trained large numbers of students from all parts of Europe, including several hundred from the British Isles[4], since 1702, when his first chemistry course (incidentally, a practical one[5]) was given in the University. It is true that work traceable directly to the influence of the *Elementa Chemiae* began early in Scotland. But it was not until 1757 that, according to Demachy, Boerhaave's *Elements* had become almost universally adopted as a teaching text[6]. This was no doubt connected with the fact that the first full translation of the work into French did not become available until 1748 and was not published in France until 1754. A Russian version is said to have been made in 1781[7], and the last

[4] J. D. Comrie, in *Memorialia Herman Boerhaave optimi medici*, Haarlem, 1939, 32. For details, *see* E. A. Peacock, *Index to English Speaking Students . . . at Leyden University*, London, 1883, and R. W. Innes Smith, *English-Speaking Students of Medicine at Leyden*, Edinburgh, 1932. A remarkably high proportion of Fellows of the Royal Society at the middle of the century had been trained at Leyden.

[5] A student's record of this course still exists in this country, in the Library of the Royal College of Surgeons of England. The MS. is entitled *Collegi Chymici Repet: ex D. D. Bourhaaven* and is a record of the course given from 25 October to 30 December, 1702.

[6] J. Demachy, *Elémens de Chymie*, Paris, 1757; *see* preface.

[7] P. Diergart, *Beiträge aus der Geschichte der Chemie*, Leipzig, 1909, 375, note 1. The reference occurs in a chapter contributed by Paul Walden, "Uber die Pflege der Chemie in Russland bis zum Ausgang des XVIII Jahrhunderts". It reads: "In russischer Sprache existieren in dieser Zeitperiode folgende chemische Lehrbücher . . . Boerhaave's Elementa chemiae (russ. 1781) . . .".

German edition was published in 1791. It is no exaggeration therefore to say that Boerhaave's influence in chemistry lasted for about a century, almost from Boyle to Dalton.

Student Versions of the Institutions and Experiments

Boerhaave's chemistry course was divided into two parts, the theoretical part being done in the summer, when the medical students required time also to study the plants in the physic garden, and the practical part in the winter. Numerous students' MSS. of these courses are still to be found in many libraries, and in several of these the two parts are clearly separated under the titles *Institutiones Chemiae* and *Chemia Experimentalis*[8]. There can be no doubt as to the popularity of the courses, with which there was nothing comparable in Britain. Yet for several years no version of his chemistry appeared, though some parts of his medical courses were surreptitiously printed. The reason for this may well have been, not that there was less demand for his chemistry, but rather that, as Shaw said, a chemistry textbook had long been expected of Boerhaave.

The first known edition of Boerhaave's chemistry was printed without his participation or consent in 1724 and was based on the courses from 1718 onwards, when he began to give special lectures on the elements, viz. fire, air, water and earth. It was these sections of the first volume of the book that gave it its special character. There have been rumours of editions earlier than this, but one suspects a confusion of the book with the *Elementa Chemiae* of Barchusen (Leyden, 1718). The earliest date mentioned, namely 1714, seems certain to have been a printer's error; it occurs in J. H. Balfour's article on Boerhaave in the *Imperial Dictionary of Universal Biography*, which says: "The works of Boerhaave are numerous, and include . . . the '*Elementa Chemiae*' (1714), a remarkable book for its time. . . ." As Balfour was writing from Edinburgh, it looks as if 1714 should have been 1741, the date of the standard English translation by Peter Shaw, which Cullen and Black recommended for many years to their students.

The first authenticated printed version is the *Institutiones et Experimenta Chemiae*, published in two volumes with the imprint Paris, 1724. According to Burton it was actually produced in Leyden[9], though no evidence for this has been found. It was the "detested piece" Boerhaave could scarcely abide

[8] Cf. Royal Society of Medicine MS. 14804, *Institutiones Chemicae*, and MS. 14801, *Chemia Experimentalis*; also the Medical Society of London MS. 121, *Institutiones Chemiae*; *Chemia Experimentalis*.

[9] W. Burton, *An Account of the Life and Writings of Herman Boerhaave*, London, 1743, 148.

seeing in his students' possession. Haller remarked that he had often witnessed Boerhaave's indignation when he noticed that "the wretched work was in everybody's hands" at his chemistry lectures[10].

Though the title of the book accurately described the names of the courses and though the contents follow closely enough the actual order of the lectures, as can be confirmed from MSS.[11], it suffered the usual faults of condensation and was considered by Boerhaave to be inaccurate and misleading. In October, 1726, he published a statement in the Leyden press[12] disclaiming all such publications issued in his name, for, he said, they were full of "gross and dangerous mistakes" that "tend equally to my discredit, and the reader's prejudice, who relies on them". When it is remembered that such texts included information on the treatment of diseases and on the formulation of medicaments, his complaint can scarcely be regarded as exaggerated.

Copies of the Paris 1724 and Venice 1726 editions of the book are fairly common (Hertzberger, items 119 and 120). The latter was published by Sebastiano Coleti and the "imprimatur" was dated 20 July, 1725. It is thus doubtful whether a Venice 1724 edition (*see* Gmelin's list[13]) actually existed, and this in turn casts doubt on a 1724 Amsterdam edition, of which no trace has been found. Neither has any copy of a Paris 1728 edition mentioned elsewhere[14] been located.

The last authenticated version of the Paris 1724 edition is the well-known English translation made by Peter Shaw and Ephraim Chambers, published with additional notes in two volumes under the title *A New Method of Chemistry*. It is accepted as the best edition of the work that was produced, for it was carefully scrutinised and collated with the most complete MSS. that could be obtained, and there appears to have been no shortage of them in the country at that time. The date at which copies of the book were first on sale is difficult to discover, and 1725, 1726 and 1727 have all been claimed. The earliest of these is a mistake that can be traced to Burton who, in his "Catalogus Operum", said

[10] *See* preface to the *Elementa Chemiae*, Leyden, 1732, and Shaw's translation, London, 1741. Haller, *Bibl. Med. Pract.*, Berne, 1776–88, iv, 150.

[11] The general plan of the courses seems to have changed little with the years, though the subject matter expanded. Certain portions of the course were made the subject of public lectures, which were used in part at least in the *Elementa Chemiae*. In the sessions 1718–19 and 1719–20 he gave special lectures on Fire, in the next two on Air and in 1722–23 on Water. These received fuller treatment in the book than in most course-notes.

[12] Given in Burton, *op. cit.*, 166.

[13] J. F. Gmelin, *Geschichte der Chemie*, Göttingen, 1798, ii, 692–3.

[14] *See* the article on Boerhaave in the *Nouvelle Biographie Générale*; from the context it seems that the 1724 Paris edition is intended. However 1728 is also given by Watt (*see* ref. 16) and by J.-M. Quérard, *La France Littéraire*, Paris, 1827, i, 368. Unfortunately the entries in the latter under Boerhaave are inaccurate.

it appeared in 1725 and gave a reference to an earlier page for further details. Here the date is given as 1727. Despite the internal evidence in Burton's account, 1725 has been perpetuated through the bibliographies of Haller and Gmelin[15]. In Watt's bibliography[16] the date of the first part is given as 1726 and of the second as 1727.

In the search for publisher's information on this point, an imperfect copy of the proposal to print an English edition of the *Chymical Institutions* was noticed in the Guildhall Library. Unfortunately the first two pages are missing and the copy bears no date. Nevertheless it referred to the 1724 Paris edition as "the Latin edition, now got abroad", which suggests that it was written not very long afterwards. It promised the translation in the ensuing May. This could not have been May, 1727, as the work was quoted by Stephen Hales in his *Vegetable Staticks*, copies of which were available some time earlier[17]. It therefore seems more likely that May, 1726, was at first the intended date of publication and that copies were to be had soon after this, though dated 1727.

The proposal clearly reflected the high opinion in which the Leyden chemistry course was held: "The new and beautiful light wherein it sets the art; the fine and uncommon notions it conveys; the large views it opens into the system of the world and its parts; with the numerous advantages it derives to human life, set it on a level with the happiest productions of the present age". Critics have always been kind to this edition of 1727, even saying that it came very near to being as lucid and reliable as the complete *Elementa Chemiae*. Boerhaave did not think so. In a letter dated 17 February, 1728 (now at the Royal Society) he wrote to William Sherard: "A l'egard de ma Chemie pretendue, je n'y reconnoie rien de moy, et proteste de l'injure, qu'on me fait toujours par toute l'Europe, en donnant sur mon nom tout ca, qu'il plait a mes Ecoliers de donner pour le mien".

At the continuous instigation of his friends, Boerhaave began the preparation of his own book at about this time. The session 1728–29 was his last as professor of chemistry, and it was during this year that the book was being put together under his supervision. Thus in the section on air he refers to Hales's *Vegetable Staticks* (1727) as having been published about two years ago, i.e. he was writing in 1729. There is further support for this in a letter to Waller, dated July, 1729, in which Cromwell Mortimer wrote: "His chemistry is in the press, just finished, under his own directions, at Leyden, in Latin and in

[15] Burton, *op. cit.*, 225, 148. A. von Haller, *Bibl. Med. Pract.* 1779, ii, bk. 12.

[16] R. Watt, *Bibliotheca Britannica*, Edinburgh, 1820, 127*g*.

[17] Hales's experiments were read at meetings of the Royal Society, beginning on 2 February, 1727, and a copy of the book was presented on 13 April (Royal Society *Journal-Book* (copy), xiii, 44–74 *passim*).

English"[18]. This presumably meant no more than that the copy prepared under his supervision was at last in the printer's hands. It is unlikely that Mortimer was misinformed, as he was in close touch with Boerhaave.

We are thus faced with the interesting probability that both the Latin version and an English translation were available more than two years before the *Elementa Chemiae* made its début in the autumn of 1731 (though dated 1732) and nearly six years before the first full English translation, namely Dallowe's, saw the light in 1735.

Was this translation Dallowe's? In his preface, Dallowe speaks as one who had attended the lectures and had done his best to keep as complete a record as possible. He was in fact enrolled as a student at Leyden in September, 1724. Dallowe also says that a number of alterations were later made to the text with Boerhaave's approval. This could only have been done if Dallowe had found an opportunity to study Boerhaave's revised text of 1729. He did indeed return to Leyden[19] in April, 1730. However, as the purpose of the visit is not known, we can merely say that these facts are consistent with the view that this English translation was Dallowe's[20].

Latin Editions of the *Elementa Chemiae*

The Latin edition (I. Severinus) was ready in the autumn of 1731, and each copy was signed by Boerhaave as a token of genuineness. Two copies were sent to Sir Hans Sloane on 15 October[21] and others were dispatched during October and November[22]. Another Leyden publisher, J. R. Imhof, issued editions at Leyden, and perhaps Tübingen and Basle[23], apparently simultaneously. In addition, it was printed in London (*sumptibus* S. K. *et* J. K.) and Leipzig (Casparum Fritsch; theory only) in 1732. A Venice 1732 edition is

[18] See *Elements of Chemistry*, trans. Dallowe, 1735, i, 314; J. Nichols, *Literary Anecdotes of the Eighteenth Century*, London, 1812, v, 425–6.

[19] Innes Smith, *op. cit.*, 62.

[20] It is of interest that the Leyden publisher Imhof secured the German publication rights for the Latin edition as early as October, 1730. The preparation of the work must have been well in hand by that time.

[21] Brit. Mus., *Sloane MS.* 3322, f. 136.

[22] H. Boerhaave, *Epistolae ad J. B. Bassand*, Vindob., 1778, 189, 191.

[23] Haller mentions Tübingen. A Basle 1732 edition is mentioned by W. Heinsius (*Allgemeine Bücher-Lexicon*, Leipzig, 1812, i, 380); as this book is priced, the entry seems genuine enough. *See* notes to Items 5 and 6 of the bibliography at the end of this article.

mentioned by Kopp and Diergart[24], but no copy has been located. The pretended Paris 1732 edition, mentioned by Davis on the authority of Hoefer[25], can be traced back to Haller via Gmelin. A strong reason for doubting it is that the Paris 1733 edition (G. Cavelier) is called the second. Though a hasty deduction would put the first at 1732, it appears probable from the title-page that the Paris 1724 edition of the *Institutiones* was regarded as the first[26].

The trio, Haller, Gmelin and Hoefer give also London, 1735, as the next Latin edition. This may well have been a mistake, for it is the date of the next item in Haller's list, namely Dallowe's translation, which surprisingly has no date against it.

Seven other Latin editions have been authenticated, namely Venice 1737; Basle 1745 (several copies are known; *see* Plate II); Venice 1749 and 1752; Paris 1753; Venice 1759 (now the most common Venice edition) and Venice 1777. Others have been claimed, but no copies have been traced. Venice 1745, mentioned first by Haller, seems likely; Basle 1747, mentioned by Gmelin and others, together with The Hague 1746, mentioned by Bolton[27], do not give rise to suspicion in any way, though no copies have yet come to light.

It is clear, as is confirmed by the preponderance of Venice editions, that Latin outside Italy was quickly losing its position as the language of the universities and of science. For the rest of Europe, after the first appearance of the Latin editions in 1732 and 1733, we must trace the spread of the *Elementa Chemiae* mainly through the various translations.

English Translations of the *Elementa Chemiae*

The first attempt at a full translation of the *Elementa Chemiae* into English was the *Elements of Chemistry, Englished by a Gentleman of the University of Oxford* (no date). Copies of the first eight sheets, called No. 1, are at the British Museum and the Medical Society of London. Neither has any information to offer about the origin of the work, though the date of publication has

[24] Diergart (*Z. angew. Chem.*, 1919, **32** (1), 58) mentioned this on the authority of Kopp (*Geschichte der Chemie*, 1843, i, 198). Diergart also referred to the editions in Bonn University Library; on inquiry, these have been found to be Leyden 1732, Leipzig 1732, London 1732, but Venice 1759.

[25] J. C. F. Hoefer, *Histoire de la Chimie*, 2nd edition, Paris, 1869, ii, 368. Hoefer's bibliographical note on these editions follows Gmelin (though with some misprints, 16— being given twice; the last two digits in each correspond to Gmelin's, so that Davis's interpretation cannot be accepted).

[26] Shaw also called his 1741 translation of the *Elementa Chemiae* the second edition, the 1727 translation of the *Institutiones* being regarded as the first.

[27] H. C. Bolton, *A Select Bibliography of Chemistry*, Washington (Smithsonian Institution), 1893, under *Boerhaave*.

been estimated as 1735. But a notice to purchasers states that it "is translated from the Author's own Edition just publish'd at Leiden, (each Exemplar being signed with his own Hand) and will be printed at least Eight Sheets at a time with all possible Expedition". Knowing that copies of the work were in London in October, 1731, it seemed more likely that the translation had appeared in 1732; but confirmation of this has taken a long time to find: only one reference to it has been discovered, and it was issued even earlier than suspected—10 January, 1732[28]. No clue as to the translator exists. This issue was of sixty-four pages only, and no more appeared. From the point of view of the history of chemistry, therefore, it is unimportant, as it quickly vanished, and no writer ever made use of it, so far as has been found.

The next English translation to appear was Dallowe's, and its possible history has been sketched already. It seems never to have been a popular work and is scarcely an inspiring translation. Nevertheless it was undoubtedly useful to those many workers in the chemical field whose Latin was inadequate for the task of reading the original text. Dallowe's translation, though a long time coming out, was the only complete English translation for the next six years.

In 1741 Shaw produced the excellent translation that became the standard English version while Boerhaave's chemistry remained in demand. Though Chambers, his collaborator on the 1727 edition, had died in 1740, and though this was a completely new work, it was nevertheless called the second edition. In the first volume Shaw added extensively to the historical section and to the earlier part of the theory, which dealt with the properties of chemical substances. His shorter notes elsewhere and references to original sources were also of value. His work as editor, as well as translator, was of the same high standard to be found in his editions of Bacon and of Boyle. Indeed, it seems a more useful treatise than the original. He also added two essays to show that chemistry was a subject of much greater extent than a student of medicine was likely to appreciate. He therefore gave hints as to ways in which chemistry could be developed, under the headings of philosophical chemistry, technical chemistry and *oeconomical* chemistry or chemistry in the home and in everyday life. The second essay dealt with a portable laboratory, and outlined schemes of courses on general chemistry, philosophical chemistry, pharmaceutical chemistry and metallurgical chemistry.

[28] *Gent. Mag.*, 1732, **2**, 591. The entry, opposite 10 January, is simply: "Numb. 1 of Elements of Chemistry, pr. 1s. 6d.". As so few scholars have been aware of this translation, it is perhaps not surprising that this entry has been overlooked for two centuries. To add to the difficulty, the page headline above the book list is conspicuously but wrongly dated January, 1731. Fortunately the pagination was continuous at this time, so there is no doubt as to the correct date.

This work was an immediate success and was always spoken of highly. A further edition, called the third, was printed in 1753. Shaw's "Boerhaave" was the best introductory chemistry text in English for a long time and generations of chemists in this country were brought up on it.

Boerhaave trained his students to be accurate and critical, and his stimulating text seems to have had the desired effect; he asked that nothing should be taken for granted and that every claim should be put to the test of experiment. It was perhaps inevitable, therefore, that he should never have lacked critics, even among his admirers. He also created among his students a feeling of loyalty, and critics were seldom allowed to air their views unchallenged. An example of this occurred in England as early as 1732–33.

In 1732 an abridged translation[29], which went to a third printing in 1737, was produced by the physician Edward Strother, a noted and prolific writer on medical subjects. The abridgment also contained "curious and useful notes, rectifying several opinions, etc., of the learned author". It was published in May, 1732[30], and seems to have found a ready market, for it appeared again in 1734 and 1737 (with an uncharacteristic portrait after G. King). It would be interesting to know why no copy of any of the three editions can be found in the national and leading scientific and medical libraries in London. Copies have been traced to the university libraries of Edinburgh and Göttingen (1732) and of Cambridge and Frankfurt am Main (1734). Only one copy of the reprint of 1737 appears to have been recorded in recent years.

This book does not live up to its title, for it was made avowedly to see how Boerhaave "would appear when stripp'd of his Harangues", and the abridger was at pains to show that he disagreed strongly with the *Elementa Chemiae* and thought that Lemery and Freind together were the only authors who presented "the true theory of chemistry". His notes were curious enough, but not at all useful: several of them were impertinent, dogmatic or misinformed. The abridgment often seems to miss the significant parts of passages. Boerhaave having said that good vinegar can be made from beer (malt vinegar), the abridger remarked: "The professor's taste is extremely bad, to recommend beer vinegar to be as good as wine vinegar". Boerhaave showed by experiment that fresh milk does not contain free acid; the abridger said: "There are so many reasons to convince us that milk contains acid, that the professor must either be weak himself, or deems the world to be such". Boerhaave on several occasions described experiments from the *Saggi di naturali Esperienze* of the Accademia del Cimento, as the work had already become rare. Once he mentioned experiment 184; but the abridger's note said there was no such experiment. This is

[29] I am indebted to Professor D. McKie and the Edinburgh University Library for the opportunity to examine a copy of this book.

[30] *Gent. Mag.*, 1732, **2**, May, *Register*, p. 7.

strictly true, but he did not explain for his readers what he doubtless knew—that it was an account of the experiment on p. 184 of the scarce 1666 edition.

The appearance of this critical book caused consternation among some of Boerhaave's former students. Joseph Rogers (Leyden student 1704) took it upon himself to act in Boerhaave's defence and produced a pamphlet[31] to this end in 1733. His opinion was that the abridger's treatment was trifling and scurrilous. He wrote: "should any learned Foreigner see such a Piece published in England, without some publick Notice and Censure on it, he might be apt to think we were again sunk into the Barbarity of Goths and Vandals". The absence of the book from the London libraries may not therefore be an accident.

A copy of Rogers's reply was sent to Boerhaave by Cromwell Mortimer, then a Secretary of the Royal Society. Boerhaave kept aloof in this as in other controversies, though his appreciative acceptance of the pamphlet is on record[32]. "I am concerned," he wrote, "that that ingenious Gentleman has lost so much of his time, upon my account, in refuting a person who has not dealt fairly by my book: which book however, I set no great value on, as being extorted from me against my will".

Strother's book was subsequently translated into German[33], though without the notes and with the added safeguard of checking against the original Latin text.

French Translations of the *Elementa Chemiae*

Before 1748 only parts of the *Elementa Chemiae* had been translated into French and published with certain of Boerhaave's medical works. An abridgment of the practical part was made by J. O. de La Mettrie and included with some editions of the *Traité de la Matière Médicale*, first in 1739. This, it has been said, was so popular that it was repeatedly reprinted[34]. An abridgment of the theory, also by La Mettrie, was printed with the addition of the *Traité du Vertige*, first in 1741. Interest in this was sufficient to justify serialisation in advance of publication[35].

[31] J. Rogers, *Some Observations on the Translation and Abridgement of Dr. Boerhaave's Chymistry*, London, 1733.

[32] Letter dated 18 February, 1734. Burton, *op. cit.*, 217, gives the original Latin; the English translation quoted here is that of the Royal Society, *Letter-Book* B3, f.21.

[33] Max Speter, in G. Bugge, *Das Buch der Grossen Chemiker*, Berlin, 1929, i, 216, note 46. The Deutsche Staatsbibliothek, Berlin, kindly traced a number of copies of two variants of this book.

[34] R. Watt, *op. cit.* Also J. E. Dezeimeris, *Dictionnaire Historique de la Médicine*, Paris, 1828, under Boerhaave.

[35] In *Observations sur les écrits modernes*, **10**, 241; **11**, 47; **13**, 193.

ÉLÉMENS
DE
CHYMIE,
PAR
HERMAN BOERHAAVE.
Traduit du Latin.
TOME PREMIER.

A PARIS, rue Saint Jacques.
Chez BRIASSON, à la Science & à l'Ange Gardien.

M. DCC. LIV.
Avec Approbation & Privilége du Roi.

(*a*)

ÉLÉMENS
DE
CHYMIE,
PAR
HERMAN BOERHAAVE.
Traduit du Latin.
TOME PREMIER.

A PARIS, rue Saint Jacques.
Chez DURAND, au Griffon, & à Saint Landry.

M. DCC. LIV.
Avec Approbation & Privilége du Roi.

(*b*)

ÉLÉMENS
DE
CHYMIE,
PAR
HERMAN BOERHAAVE.
Traduit du Latin.
TOME PREMIER.

A PARIS, Quai des Auguſtins.
Chez GUILLYN, au Lys d'Or.

M. DCC. LIV.
Avec Approbation & Privilége du Roi.

(*c*)

PLATE I. Three variants of the Paris 1754 edition of the *Elementa Chemiae*, translated by J. N. S. Allamand.
Reproduced by courtesy of (*a*) Koninklijke Nederlandse Maatschappij tot Bevordering der Geneeskunst[3]; (*b*) and (*c*) Wellcome Historical Medical Museum.

ELEMENTA CHEMIAE,

QUAE
ANNIVERSARIO LABORE DOCUIT,
IN PUBLICIS, PRIVATISQUE,
SCHOLIS,

HERMANNUS BOERHAAVE,

TOMUS PRIMUS.
QUI CONTINET HISTORIAM ET ARTIS
THEORIAM.
CUM TABULIS AENEIS.
CUM PRIVILEGIIS CÆSAREO, POLONICO & SAXONICO.

BASILEÆ,
Sumtibus JOANNIS RUDOLPHI IM-HOFF.
M DCC XLV.

Hermann Börhaavs

Anfangsgründe

der

Chymie

praktiſcher Theil,

aus dem Lateiniſchen überſetzt.

Zwote Auflage, mit Anmerkungen

von

Johann Chriſtian Wiegleb.

Mit nöthigen Kupfern

Danzig, 1791.
bei Ferdinand Troſchel.

PLATE II. (*Left*). Title-page of the Basle 1745 edition, the only Swiss edition so far traced. Reproduced by courtesy of the Öffentliche Bibliothek der Universität Basel. (*Right*). The last known edition of the *Elementa Chemiae*, Volume II. Reproduced by courtesy of the Chemical Society, London.

The French translation of Boerhaave's theory by J. N. S. Allamand, published first at The Hague, appeared in 1748. It was very well received and was widely quoted during the following twenty years or more. Allamand dedicated the work to Gaubius of Leyden, who was nominated by Boerhaave as his successor in chemistry and who revised the whole translation before publication. In 1752 it went through three more editions—Leyden; Amsterdam and Leipzig; and again Amsterdam (Wetstein). At last in 1754 it was published in Paris, with additional material selected by P. Tarin, who looked after the anatomy and physiology in the *Encyclopédie*. The book was published simultaneously by Briasson, Guillyn and Durand. Briasson had a half-interest in this work, the rest being divided between Guillyn and Durand. Copies bearing the names of each of them are known (Plate I), but apparently have not been reported previously. The issues seem to be identical, apart from the names of the book-sellers.

The dates of the first and last of these editions are given by Gmelin as 1747 and 1755, but according to the present evidence they should be 1748 and 1754.

German Translations of the *Elementa Chemiae*

The first German translation was the work of "F.H.G. M.D.". This, like all subsequent German versions, was a translation of the second volume only. It was issued at Halberstadt (Schopp) in nine parts, the first five being dated 1733 and the last four 1734. Whereas in France interest centred on Boerhaave's theory, in Germany emphasis was laid on his practical volume, little attention being paid to the theory[36]. Haller mentioned a Halberstadt edition of 1748, but no supporting evidence has yet come to light.

The next German translation, a different one, was published at Leipzig (Blochberger) in 1753, in three parts. There was also a Berlin (Nicolai) edition in 1762. The third part of this book—the section dealing with mineral substances—was separately paginated, as was the second edition of it, issued in 1782 at Berlin and Stettin. No copy of this has yet been traced, but its existence seems certain. It was again issued at Danzig (Troschel) in 1791, as stated by Kayser and Heinsius. The only copy traced so far is in the Roscoe collection in the Library of the Chemical Society. Bolton and others give this as the date of a Berlin edition, but no copy is yet known to me. The Danzig edition appears to have been identical with the 1782 edition, this being the date of the preface, but it had a new title-page (Plate II). The name of the translator of the 1782 and 1791 editions is sometimes given as J. C. Wiegleb, but it

[36] This implies a difference of outlook which became particularly noticeable after 1750, when Boerhaave's chemistry enjoyed a vogue in France that was scarcely matched elsewhere.

seems that this conclusion has been due to a wrong reading of the title-page. The 1782 and 1791 editions differed from that of 1762 by having a considerable number of notes, which, as is indicated at the end of the preface (presumably dated 1782 in both), was characteristic of the second edition. Thus we know no more than that Wiegleb was the author of the notes. All the prefaces to these editions (1753, 1762, 1782, 1791) were signed "at Leipzig", and they are all the same translation, apart from very minor amendments.

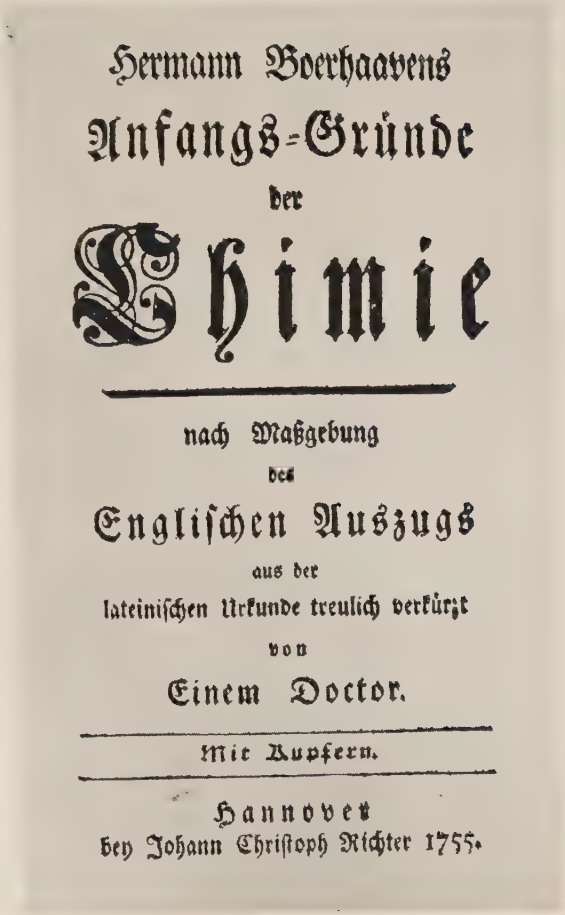
Among the several unsolved problems in Boerhaave bibliography is the identity of the Hannover, 1755 edition of the *Elements* which, according to Kayser and Heinsius, was published by Helwing. Copies of two variants of a Hannover 1755 abridgment are in several German libraries (Plate III) but all of them bear the name of J. C. Richter on the title page. They are in fact a German translation of Strother's English abridgment. The preface by the translator is not signed, and in the absence of further information one is tempted to conclude that Richter was the translator. According to Gmelin this work first appeared at Göttingen in 1754, where, incidentally, there was an active school adhering to the Leyden tradition, formerly led by such men as Haller and G. G. Richter; indeed, in 1744 G. C. Starck of Göttingen wrote a defence of Boerhaave against certain English critics of his medical views[37]. In view of this, it seemed worthwhile to find what English translations of Boerhaave's chemistry existed in the Göttingen University Library, and it was learnt with some surprise that they included a copy of Strother's very rare abridgment of 1732—the one from which the German version was made[38]. It is difficult to know what conclusions, if any, can be drawn from this. The preface is unhelpful; it merely gives the information that the translation was made at the request of a young gentleman, no doubt a student, and that the people to whom the English abridgment was shown all agreed that the abridger's notes should be omitted. Furthermore the German translation was checked against Boerhaave's original before publication.

Experiments on Mercury

Boerhaave, more than any other chemist, attempted to put the claims of the alchemists to the test of experience without in any way pre-judging the outcome. To this end he carried out a series of experiments on the metals, some lasting

[37] G. C. Starck, *Prolusio Exibens vindicias Hermanni Boerhaavii adversus censorem anglum*, Göttingen, 1744, in G. G. Richter, *Opuscula Medica*, Frankf. et Lips., 1781, iii, 140.

[38] The others are Shaw's 1741 translation and *Some experiments concerning Mercury*, London, 1734.



Hermann Boerhaavens
Anfangs-Gründe
der
Chimie

nach Maßgebung
des
Engliſchen Auszugs
aus der
lateiniſchen Urkunde treulich verkürzt
von
Einem Doctor.

Mit Kupfern.

Hannover
bey Johann Chriſtoph Richter 1755.

(a)

Eines Engländers
Auszug
aus
Hermann Boerhaave
Anfangs-Gründen
der
Chimie

überſetzt
von * * *
Medic. Doctor.

Mit Kupfern.

Hannover
bey Johann Chriſtoph Richter 1755.

(b)

PLATE III. Two variants of J. C. Richter's German edition (1755) of Edward Strother's abridgment (1732). Reproduced by courtesy of (*a*) Gmelin-Institut, Frankfurt am Main; (*b*) Universitätsbibliothek, Münster (Westf.).

many years. These experiments seem to have been recorded in what is called his chemical diary, part of a collection of manuscripts taken to Russia after his death[39] and rediscovered there not very long ago[40]. The most celebrated of the experiments were those on mercury, which proved beyond a doubt that the metal gave black and red calces, which on heating alone (that is, without the addition of charcoal) returned to the metal. This was, indeed, part of an unfinished scheme of work[41] designed to show that Becher and Stahl had been deceived in their beliefs about the regeneration of metals from their calces.

Through the interest of Cromwell Mortimer, the experiments on mercury were printed in the *Philosophical Transactions* in three parts in 1734 and 1736. The first part was published separately in English translation in 1734; French versions appeared in the memoirs of the Paris Academy in 1734 and in de Brémond's translation of the *Philosophical Transactions* for 1736 (published 1738). A German translation of the third part was given in the *Hamburgisches Magazin* for 1750. In addition to the separate English translation, separate Latin editions were published at Utrecht (1735), Frankfurt and Leipzig (1736), and Venice (1737). The experiments were also included in the various abridgments of the *Philosophical Transactions* and in most editions of Boerhaave's shorter works under the titles of *Opera Omnia Medica* and *Opuscula Omnia*[42]. These included his two addresses given on taking up and on relinquishing the professorship[43].

[39] The story of this episode is told in a letter of Gronovius to Richardson (Sir J. E. Smith, *A Selection of the Correspondence of Linnaeus*, London, 1821, ii, 188) and by Matthew Maty (*Eloge Critique de M. Herman Boerhaave*, Cologne, 1747, 96, footnote). The chemical diary was bequeathed by Herman Kaau, a nephew of Boerhaave, to C. F. Kruse, who used it in preparing a paper entitled "Ad observationes et experimenta de Mercurio ex manuscriptis Hermanni Boerhaave", in *Novi Comm. Acad. Sci. Imp. Petropol.*, 1764, **9**, 381.

[40] *See* — Kholodnyakova (compiler), *Katalog der wiedergefundenen Manuskripte und Briefwechsel von Herman Boerhaave*, translated by Ernst Cohen and W. A. T. Cohen—de Meester, in *Verh. Akad. Wet. Amst.*, Afd. Natuurkunde, Sect. 2, dl. 40, no. 2.

[41] Burton, *op. cit.*, 157.

[42] Editions published at The Hague, 1737, 1738; Naples, 1751; and Venice, 1735 (*ed. nova*), 1742, 1751, 1757, 1766, 1783, 1790. (I have not seen a copy of the Venice 1735 edition, but the description suggests that new matter was included in it). It has been said that the experiments were included in some editions of Mead's works, but the nearest I can find is A. Kaau Boerhaave's "Discours Academique sur les Qualités qui constituent et perfectionnent les Médecins", in Mead's *Avis et Préceptes de Medecine*, Paris (D'Houry), 1757.

[43] These were: *Sermo Academicus De Chemia suos errores expurgante*, Leyden, 1718, and *Sermo Academicus quem habuit, quum honesta Missione impretata, Botanicam & Chemicam Professionem publice poneret . . .*, Leyden, 1729.

BIBLIOGRAPHY

In the list that follows, only independent publications are given, together with specimen locations where copies are known to be held[44]. These locations are intended to be representative but not in any way exhaustive. The works listed are the only ones that have been authenticated in this inquiry, which has been restricted in both aim and scope. Some other editions doubtless exist, particularly in American and French libraries and collections, and I should be most grateful for information about them. In conclusion, I express my warmest thanks to those many librarians and others who have taken considerable pains to give full answers to my questions. It is regretted that they could not all be mentioned in this account.

[44] Key to locations cited: HR, followed by a number, refers to the items listed in Hertzberger's *Short-title Catalogue*, the works being in the Amsterdam University Library (*see* footnote 3 above); AC, author's copy; BCM refers to Sotheran, *Bibl. Chemico-Math.*, 2nd *Supplement*, i, 657 (present location of copy in question unknown); BM, British Museum; BNC, Biblioteca Nazionale Centrale, Florence; BNP, Bibliothèque Nationale, Paris; BNV, Biblioteca Nazionale di S. Marco, Venice; CSL, Library of the Chemical Society; CUL, Cambridge University Library; DLB, Sächsische Landesbibliothek, Dresden; EUL, Edinburgh University Library; GLB, Öffentliche Bibliothek der Universität Basel; GMI, Gmelin-Institut, Frankfurt am Main; HAB, Herzog August Bibliothek, Wolfenbüttel; LBU, Bibliothèque Cantonale et Universitaire, Lausanne; LLM, Lenin State Library, Moscow; LSL, Saltikov-Shchedrin State Library, Leningrad; MSL Medical Society of London; MSU, Moscow State University Library; PHS, Pharmaceutical Society of Great Britain; POL, Patent Office Library, London; RCP, Royal College of Physicians, London; RCS, Royal College of Surgeons of England, London; RSM, Royal Society of Medicine, London; SBF, Senckenbergische Bibliothek, Frankfurt am Main; SGL, Surgeon-General's Library, Washington (National Library of Medicine); UBB, Universitätsbibliothek, Bonn; UBG, Niedersächsische Staats- und Universitätsbibliothek, Göttingen; UBM, Universitätsbibliothek, Münster; UCL, University College, London; UFM, Institut für Geschichte der Naturwissenschaften, J. W. Goethe-Universität, Frankfurt am Main; ULB, Stadt- und Universitäts-Bibliothek, Berne; WDB, Westdeutsche Bibliothek, Marburg/Lahn; WL, Wellcome Historical Medical Library, London.

Institutiones et Experimenta Chemiae

1. Hermanni Boerhaave Phil. et Med. Doctoris, Medicinae, Botanices, Chemiae et Collegii Practici, Lugduni Batavorum, Professoris, Regiae Scientiarum Academiae Socii Institutiones et Experimenta Chemiae.
   Tomus Primus. Parisiis MDCCXXIV. 2 leaves + pp. 290.
   Tomus Secundus. Parisiis. MDCCXXIV. 8 leaves + pp. 375. 1 Plate. (The Plate is missing from several copies.)
   (BM; RCS; UCL; HR 119.)

2. *Idem* . . . Venetiis, 1726, apud Sebastianum Coleti, Superiorum venia et Privilegio. 2 Vols., with 1 Plate. Pp. 292; 12, 351.
   (BNC; HR 120.)

3. A New Method of Chemistry; including the Theory and Practice of that Art: Laid down on Mechanical Principles, and accommodated to the Uses of Life. The whole making a clear and rational system of Chemical Philosophy. To which is prefix'd A Critical History of Chemistry and Chemists, From the Origin of the Art to the present Time. Written by the very Learned H. Boerhaave, Professor of Chemistry, Botany, and Medicine in the University of Leyden, and Member of the Royal Academy of Sciences at Paris. Translated from the Printed Edition, Collated with the best Manuscript Copies. By P. Shaw, M.D. and E. Chambers, Gent. With additional Notes and Sculptures. London: Printed for J. Osborn and T. Longman, at the Ship in Pater-noster-Row. M.DCC.XXVII.
8 leaves + pp. 383 + 2 Plates; pp. 335.
(BM; PHS; RCS; WL; HR 102.)

Elementa Chemiae

4. Elementa Chemiae, quae anniversario labore docuit, in publicis, privatisque, scholis, Hermannus Boerhaave.
Tomus Primus. Qui continet historiam et artis theoriam. Cum tabulis aeneis. Lugduni Batavorum, Apud Isaacum Severinum. M.D.CCXXXII. (Signature *H. Boerhaave* on reverse.) 6 leaves + pp. 896 + Plates 17 + 37 leaves (description of Plates and Index).
Tomus Secundus. Qui continet Operationes Chemicas. 2 leaves + pp. 538 + 2 leaves (Conspectus seriei chemicarum operationum ad leges disciplinae; bound between pp. 14 and 15 or at front of volume) + 23 leaves (Index).
(WL; HR 93.)

5. *Idem* . . . Cum Privilegiis Caesareo, Polonico & Saxonico. Lugduni Batavorum, Sumtibus Joannis Rudolphi Imhof. M.D.CCXXXII.
Pagination corresponds exactly to Item 4, except for the Privilege in German at the front of Vol. I and in Latin at front of Vol. II. It also contains instructions to the binder, in German, at the foot of the description to Plate XVII. This may be the so-called Tübingen edition[23].
(MSL.)

6. *Idem* . . . Cum Privilegiis Caesareo, Polonico & Saxonico. Lugduni Batavorum, Sumtibus Joannis Rudolphi Im-hoff. MDCCXXXII.
No German overprint on Plate XVII. This is a different setting from Item 5 (though pagination corresponds) and the layout of the title-page is that of Item 11. The vignette on p. 896 is different from that of Item 5. This seems to correspond to the Basle 1732 edition[23].
(WL.)

7. *Idem* . . . Cum Privilegio Pot. Regis Pol. & El. Sax. Lipsiae, Apud Casparum Fritsch. MDCCXXXII.
8 leaves + pp. 356 + Volumen Secundum, 2 leaves + pp. 359–744 + 38 leaves.
(RSM; WL.)

8. *Idem* . . . Sumptibus S.K. et J.K. Londini, 1732.
3 leaves + pp. 344 + 17 Plates + 25 leaves (description of Plates and Index); pp. 209 + 19 leaves (Index).
(GMI; UBG; HR 95.)

9. *Idem* . . . Editio altera, Leydensi multo correctior et accuratior. Cui etiam accessere ejusdem Auctoris Opuscula omnia . . ., Parisiis, Apud Guillelmum Cavalier, Viâ Jacobeâ, sub Signo Lilii Aurei, M.DCC.XXXIII. Cum Approbatione, & Privilegio Regis.
Tomus Primus. 6 leaves + pp. 476 + 17 plates + 31 leaves (descriptions of Plates and Index). At end: Ex Typographia Claudii Simon.
Tomus Secundus. 4 leaves + pp. 346 + 24 leaves (index). With Hermanni Boerhaave, . . . Opuscula Omnia. Parisiis, M.DCC.XXXIII. 2 leaves + pp. 231.
(WL; UCL; HR 96.)

10. *Idem* . . . Venetiis, 1737.
(HR 97.)

11. *Idem* . . . Cum Privilegiis Caesareo, Polonico & Saxonico. Basileae, Sumtibus Joannis Rudolphi Im-hoff. MDCCXLV.
Pagination corresponds to that of Item 6 above.
(GLB; ULB; WDB; LSL.)

12. *Idem* . . . Venetiis, 1749. Apud Sebastianum Coleti. Superiorum Permissu, Ac Privilegio.
4 leaves + pp. 499 + 17 Plates + 17 leaves (description of Plates); 4 leaves + pp. 331.
(WL; MSU.)

13. *Idem* . . . Venetiis, 1752.
(HR 98.)

14. *Idem* . . . Apud Viduam & Filium Guillelmi Cavalier . . . M.DCC.LIII.
Same pagination as Item 8. Ex Typographia Viduae Quillau.
(UCL; WL; HR 99. This item is given by Hertzberger as 1752–53, but the date in the Amsterdam copy is 1753.)

15. *Idem* . . . Venetiis, MDCCLIX. As Item 12.
(WL; HR 100.)

16. *Idem* . . . Venetiis, 1777.
(HR 101.)

English Translations

17. Elements of Chemistry. Being the Annual Lectures of Hermann Boerhaave, M.D. In Two Volumes. Illustrated with several Copper Plates. Englished by a Gentleman of the University of *Oxford*. Numb. I. London: J. Clarke and S. Austen; sold by J. Roberts. (Price 1s. 6d.).
First 8 sheets (32 leaves) only.
(BM; MSL.)

18. Elements of Chemistry: being the Annual Lectures of Herman Boerhaave, M.D. Formerly Professor of Chemistry and Botany, And at present, Professor of Physick in the University of Leyden. Translated from the Original Latin, By Timothy Dallowe, M.D. London: Printed for J. and J. Pemberton, in Fleetstreet; J. Clarke, under the Royal Exchange; A. Millar, in the Strand; and J. Gray in the Poultry. MDCCXXXV.
Vol. I. Pp. xii + 528 + 17 Plates + 4 leaves (Index).
Vol. II. 4 leaves + pp. 376 + 8 leaves (Index and book notices).
(AC; BM; PHS; WL.)

19. A New Method of Chemistry; including the History, Theory, and Practice of the Art: Translated from the Original Latin of Dr. Boerhaave's Elementa Chemiae, As Published by Himself. To which are added, Notes; and an Appendix, shewing The Necessity and Utility of Enlarging the Bounds of Chemistry. With Sculptures. By Peter Shaw, M.D. The Second Edition. London: Printed for T. Longman, at the Ship in Paternoster-Row. M.DCC.XLI. Pp. xxx + 593 + 17 Plates.
Vol. II. Title + pp. 410 + 8 Plates + 19 leaves (Index).
(AC;RCS; HR 103.)

20. *Idem* . . . By Peter Shaw, M.D. F.R.S. The Third Edition Corrected. London: Printed for T. and T. Longman, in Paternoster-Row. MDCCLIII.
Pp. xxx + 593 + 17 Plates.
Vol. II. The Third Edition, corrected. London: Printed for T. and T. Longman, at the Ship in Pater-Noster-Row. M.DCC.LIII.
Title + pp. 410 + 19 leaves + 8 Plates.
(EUL; PHS; HR 104.)

English Abridgment

21. Dr. Boerhaave's Elements of Chymistry, faithfully Abridg'd From the late Genuine Edition, Publish'd and sign'd by himself, at Leyden. With all the Cuts and Explanations, as in the Original. To which are added, Curious and Useful Notes, Rectifying several Opinions, &c. of the learned Author. By a Physician. London: Printed for J. Wilford, behind the Chapter-house in St. Paul's Church-yard. MDCCXXXII. 3 leaves + pp. 210.
An Abridgement of Tome II. 4 leaves + pp. 208 + 5 leaves (Indexes) + 17 Plates + 17 pages (explanation of the Plates) + errata.
(EUL; UBG; SGL.)

22. *Idem* . . . Second Edition. 1734.
(CUL; SBF.)

23. *Idem* . . . with portrait after G. King. 1737.
(BCM.)

German Re-Translation of Abridgment

24. Eines Engländers Auszug aus Herman Boerhaave Anfangs-Gründen der Chimie übersetzt von *** Medic. Doctor. Mit Kupfern. Hannover bey Johann Christoph Richter 1755.
2 leaves + pp. 588 + 1 Plate.
(DLB; UBM.)

25. Hermann Boerhaavens Anfangs-Gründe der Chimie nach Massgebung des Englischen Auszugs aus der lateinischen Urkunde treulich verkürzt von Einem Doctor. Mit Kupfern. Hannover bey Johann Christoph Richter 1755.
Otherwise same as Item 24.
(GMI; HAB; MSU; UFM; HR 111.)

French Translations

26. Elémens de Chymie, trad. du Lat. par J. N. S. Allamand. La Haye: J. Neaulme, 1748. 2 vols.
(HR 105.)

27. Elémens de Chymie par Herman Boerhaave: Traduits du Latin Par J. N. S. Allamand, Membre de la Société Royale de Londres.
Tome Premier. A Amsterdam, Chez J. Wetstein, MDCCLII. 10 leaves + pp. 560 + 8 Plates.
Tome Second. 2 leaves + pp. 561–914 + Plates 9–17 + 10 leaves (Index).
(WL.)

28. *Idem* . . . Leide, C. Haak, 1752.
(MSU; HR 106.)

29. *Idem* . . . Amst. & Leip., Arkstee et Merkus, 1752.
(HR 107.)

30. Elémens de Chymie, par Herman Boerhaave. Traduit du Latin. M.DCC.LIV. Avec Approbation & Privilége du Roi.
A Paris, rue Saint Jacques. Chez Briasson, à la Science & à l'Ange Gardien.
Tome Premier. Pp. cvi + 313 (wrongly numbered 213).
Tome Second. Title + pp. c + 333.
Tome Troisieme. 2 leaves + pp. 336.
Tome Quatrieme. 2 leaves + pp. 227 + pp. 212.
Tome Cinquieme. 2 leaves + pp. 466.
Tome Sixieme. 2 leaves + pp. 216 + Plates 17 + pp. 217–269.
(Vol. I of *Elementa Chemiae* only.)
(HR 108.)

31. *Idem* . . ., A Paris, rue Saint Jacques. Chez Durand, au Griffon, & à Saint Landry.
(WL; LLM.)

32. *Idem* . . ., A Paris, Quai des Augustins. Chez Guillyn, au Lys d'Or.
(WL; BNP.)

French Abridgments

33. Traité de la Matière Médicale, pour servir à la Composition des Remédes indiqués dans les Aphorismes. Par M. Herman Boerhaave. Auquel on a ajoûté les Opérations Chimiques du même Auteur, &c. A Paris, rue S. Jacques, Chez Huart . . . Briasson . . . M.DCC.XXXIX. Avec Approbation & Privilege du Roy.
Pp. xi + 560 + 2 leaves.
(WL.)

34. *Idem* . . ., Nouvelle Edition. A Paris, Chez Guillyn, Quai des Augustins, au Lys d'or. M.DCC.LVI. Avec Approbation & Privilége du Roi.
Pp. x + 1 leaf (Privilege) + pp. 466 + 1 leaf (errata).
(MSL.)

35. Abregé de la Theorie Chymique. Tiré des propres Ecrits de M. Boerhaave. Par M. de la Metrie. Auquel on a joint le Traité du Vertige, par le même. A Paris, Rue S. Jacques, Chez Antoine-Claude Briasson . . . MDCCXLI. Avec Approbation & Privilege du Roi.
4 leaves + pp. 159 + Traité du Vertige, 3 leaves + pp. 167–301 + 1 leaf (Table).
(BM.)

36. *Idem* . . ., A Paris, Rue S. Jacques, Chez Lambert & Durand, Libraires, a S. Landry, a la Sagesse & au Griffon. MDCCXLI.
4 leaves + pp. 301 + 1 leaf.
(MSL; LSL.)

German Translations

37. Hermann Boerhaavens Elementa Chemiae Oder Anfangs-Gründe Der Chymie . . . aus dem Lateinischen ins Teutsche übersetzet F. H. G. M.D. . . . Halberstadt, Bey Christian Friderich Schopp, Buchh. 1733. Portrait.
8 leaves + pp. 1044 + 10 leaves (Index).
(In 9 parts, 1–5 dated 1733 and 6–9 dated 1734.)
(WL; HR 109.)

38. Herrn Hermann Boerhaavs, Hoch-berühmt gewesenen Profess. Medicinae zu Leyden, Elementa Chemiae, Oder: Anfangs-Gründe der Chymie, Worinnen der Herr Auctor durch 227 Processe gründliche Anweisung gegeben, Auf was Art die natürlichen Cörper können Kunstmässig analysirt, oder Chymisch aufgeschlossen und daraus heilsame Artzeneyen bereitet werden, . . . Mit Kupfern. Mit allergnädigsten Privilegio. Leipzig, verlegts Michael Blochberger, 1753. Portrait.
14 leaves + pp. 1032 + 26 leaves (Index) + 9 Plates. (The ninth Plate, which is unnumbered, should be found opp. p. 990.)
(WL; HR 110.)

39. Hermann Boerhaavs weil. berühmten Professors der Artzneygelahrheit zu Leiden Anfangsgründe der Chymie oder gründliche Anweisung auf was Art die natürlichen Cörper können chymisch aufgeschlossen, und daraus heilsame Artzeneyen bereitet werden. aus dem Lateinischen ins Deutsche übersetzt. Nebst einem nützlichen Anhange von chymischen Geräthschaften, von Anwendung sowohl des Florentischen als Fahrenheitischen Thermometers, und von den Graden des Feuers bey Bearbeitung chymischer Processe. Mit nöthigen Kupfern und allergnädigster Freyheit. Berlin, bey Friedrich Nicolai. 1762. Portrait.
(Preface signed Leipziger Michaelis-Messe, 1761.)
4 leaves + pp. 440 + pp. 272 + 28 leaves (Indexes) + 8 leaves (Plates).
(BM; MSU.)

40. Hermann Börhaavs weiland berühmten Professors der Arzneygelahrtheit zu Leiden Anfangsgründe der Chymie praktischer Theil, aus dem Lateinischen übersetzt. Zwote Auflage, mit Anmerkungen von Johann Christian Wiegleb. Mit nöthigen Kupfern. Danzig, 1791. bei Ferdinand Troschel. (Preface signed Leipsiger Ostermesse, 1782.)
2 leaves + pp. 476 + pp. 270 + 24 leaves (Indexes) + 8 leaves (Plates).
(CSL.)

Experiments on Mercury

41. Some Experiments concerning Mercury. By J. H. Boerhaave, Professor of Physick at Leyden. Translated from the Latin, communicated by the Author to the Royal Society. London: Printed for J. Roberts, near the Oxford-Arms, in Warwick-Lane. MDCCXXXIV. Half-title + pp. 55.
(MSL; POL; RCP; HR 162.)

42. De Mercurio Experimenta . . . Trajecti ad Rhenum, apud Jurrianum a Paddenburg, 1735. Pp. 43.
(BNP; DLB; MSU; UBG; HR 161.)

43. Hermanni Boerhaave A. L. M. Philos. et Med. Doct. Densi Prof. Colleg. Chirug. Praes. Reg. Soc. Lond. Nec Non Reg. Scient. Acad. Parisiensis Socii De Mercurio Experimenta in Transaction. Regiae Soc. Lond. Anni MDCCXXXIII. N.430. Contenta. Francofurti & Lipsiae, Apud Petr. Conr. Monath. MDCCXXXVI. Pp. 23.
(EUL; MSU; UBB; LBU.)

44. Hermanni Boerhaave De Mercurio Experimenta. Venetiis, Ex Thipographia Hertiana MDCCXXXVII. Superiorum Permissu. Pp. 32.
(WL; BNV.)

ON FIVE HITHERTO UNRECORDED COPIES OF JEAN REY'S *ESSAYS* OF 1630

By Douglas McKie*

That Jean Rey's *Essays* is probably the rarest of all historical works in the literature of chemistry is generally well-known to everyone interested in the history of that science. The full title of the book is *Essays de Iean Rey Doctevr en Medecine. Svr la recerche de la cause pour laquelle l'Estain & le Plomb augmentent de poids quand on les calcine.* It was printed by Guillaume Millanges at Bazas in 1630 without either *licence* or *privilège.* Millanges was a well-known printer of Bordeaux and it has been suggested that the appearance of the book at Bazas instead of Bordeaux may have been due to the outbreak of plague in Bordeaux in 1629–30, which may have led Millanges to set up a small temporary press at Bazas, some thirty miles distant from the infected city. Millanges, it might be added, was a good printer and he produced work of a high standard. But his printing of Rey's *Essays* fell far short of his usual performance. The types used were worn; there were many abbreviations, as if there were a shortage of characters, and the punctuation was defective. It is possible that the book was not published in the usual meaning of the word, but rather printed for private circulation among the author's friends and among others who might be interested in the subject that it dealt with. Whether this suggestion be correct or not, the work seems to have attained no wide circulation; and mention of it is very rare until its "re-discovery" was announced in January 1775[1] by Pierre Bayen (1725–1798), *Apothicaire-Major des Camps & Armées du Roi*, at a time when Lavoisier was propounding his first theoretical speculations on the gain in weight of metals on calcination and on the part played by air in that phenomenon.

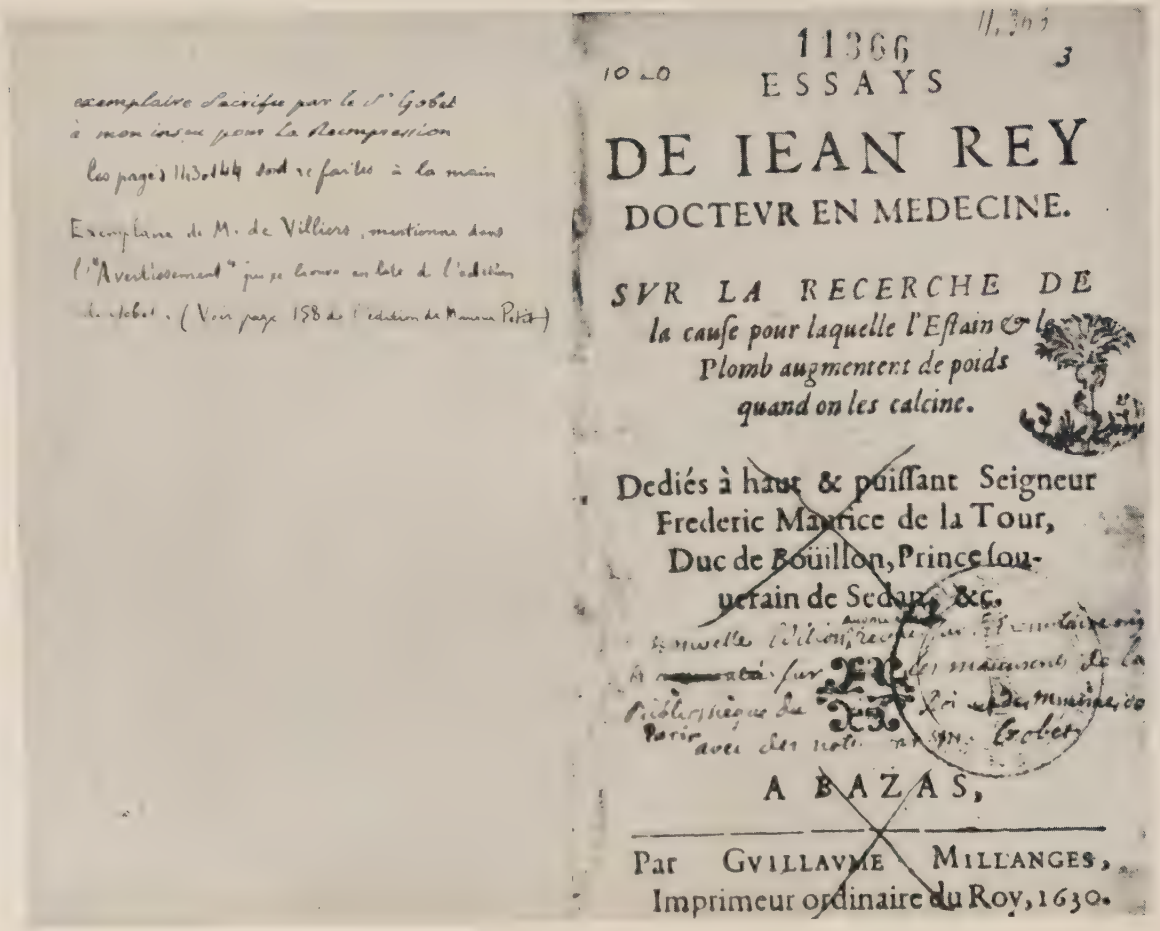
In the meantime, however, for almost a century and a half after the original publication of 1630, there had been scant mention of the *Essays*, except by three bibliographers, although admittedly three bibliographers of note, namely, Pierre Borel (*c.* 1620–1689)[2], Raphaël Trichet du Fresne (1611–1661)[3], and the

* Department of the History and Philosophy of Science, University College, London.

[1] *Observations sur la Physique*, 1775, **5**, 47.

[2] Pierre Borel, *Bibliotheca Chimica* etc., Paris, 1654, p. 196: 2nd edition, Heidelbergæ, 1656, p. 185*f*.

[3] Raphaël Trichet du Fresne, *Catalogvs Librorvm Bibliothecæ Raphaelis Trichet dv Fresne*, Paris, 1662, in the section entitled *Philosophi, Medici, Anatomistæ . . . Scriptores.*



exemplaire sacrifié par le Sr Gobet
à mon insçu pour la Recomposition
les pages 1143 et 144 sont refaites à la main

Exemplaire de M. de Villiers, mentionné dans
l'Avertissement que je trouve en tête de l'édition
de Gobet. (Voir page 158 de l'édition de Maurice Petit)

11366
3

ESSAYS
DE IEAN REY
DOCTEVR EN MEDECINE.

SVR LA RECERCHE DE
la cauſe pour laquelle l'Eſtain & le
Plomb augmentent de poids
quand on les calcine.

Dediés à haut & puiſſant Seigneur
Frederic Maurice de la Tour,
Duc de Bouillon, Prince ſou-
uerain de Sedan, &c.

A BAZAS,

Par GVILLAVME MILLANGES,
Imprimeur ordinaire du Roy, 1630.

PLATE IV. By courtesy of the Faculté de Pharmacie, Paris.

Title-page of de Villiers's copy of the original edition of Rey's *Essays* (1630) marked by Gobet for his reprint (1777) and opposing page with notes by de Villiers and another (unknown).

Abbé Nicolas Lenglet Dufresnoy (1674–1755)[4], and one writer of a text-book of chemistry, Jacob Reinbold Spielmann (1722–1783)[5], professor of chemistry, botany and *materia medica* in the University of Strasbourg.

Bayen's announcement of 1775 drew attention at last to the *Essays* and in 1777 a reprint was published under the editorship of Nicolas Gobet (*c.* 1735–*c.* 1781)[6], mineralogist, co-editor with Faujas de Saint Fond of the *Œuvres* of Palissy, published also in 1777. The rarity of the *Essays* was mentioned by Bayen and implied by Gobet. Bayen stated that he had access to a defective copy in the library of de Villiers, a Paris physician, the copy having been acquired by the latter in 1774 at the sale in Paris of the library of the late M. Villars, physician at La Rochelle. Bayen added that there was, however, a perfect copy in the Bibliothèque du Roi (now the Bibliothèque Nationale, Paris), and that with this copy there were included copies made by Pierre Trichet, father of Raphael Trichet du Fresne, of two manuscript letters, one from Mersenne to Rey and the other from Rey to Mersenne. These letters and others reproduced by Gobet in his reprint of the *Essays* have since disappeared and so has the copy of the *Essays* that formerly belonged to Pierre Trichet and which was mentioned in Trichet du Fresne's catalogue referred to above[7]. The copy of the *Essays* now preserved in the Bibliothèque Nationale is a duplicate transferred from the Bibliothèque Mazarine in 1934. Gobet had something to say about Trichet's copy: he stated that it passed to the Bibliothèque du Roi and that the Abbé Desaunays had kindly sent it to him. He added that "M. de Villiers, dont la Bibliothèque est si précieuse, dont l'érudition & les Ouvrages sont connus des Chymistes, a bien voulu sacrifier son exemplaire en faveur du bien public, & en considération de notre ancienne amitié; c'est celui qui a servi à l'impression". Gobet clearly regarded the book as rare. It is interesting to see that, as appears below, the copy "sacrificed" by de Villiers and used by Gobet has now been traced in Paris. The other copy has long been missing: perhaps it was not returned.

Grimaux, commenting in 1884 on Gobet's reprint[8], stated that Gobet knew

[4] Nicolas Lenglet Dufresnoy, *Histoire de la Philosophie hermétique*, La Haye, 1742, vol. iii, in the section entitled *Auteurs connus seulement depuis l'impression de ce Catalogue*. The date of Dufresnoy's death is variously given as 1752 or 1755.

[5] Jacob Reinbold Spielmann, *Institutiones Chemiæ*, 2nd edition, Strasbourg, 1766, p. 275, and in the unpaginated *Syllabus Auctorum* appended: French translation by L. C. Cadet, *Instituts de Chymie*, Paris, 1770, vol. ii, p. 120. The reference to the *Essays* occurs only in the second edition of the *Institutiones*, not in the first edition of 1763.

[6] *Essays de Iean Rey, Docteur en Médecine* etc. . . . *Nouvelle Edition . . . Avec des Notes par M. Gobet*, Paris, 1777, *Avertissement*, pp. x–xj.

[7] Reinhold Dezeimeris, *Actes de l'Acad. Nat. des Sciences, Belles-Lettres et Arts de Bordeaux*, 1877–78, 510–529.

[8] E. Grimaux, *Rev. Sci.*, 1884, **7** (iii), 408–409.

only two copies of the original edition of 1630, as is indicated above, but he drew attention to the existence of three other copies, one already mentioned by Dehérain[9] and preserved in the Bibliothèque Mazarine, another in the Bibliothèque du Conservatoire National des Arts et Métiers and another in the Bibliothèque de la Ville de la Rochelle.

Grimaux did not, however, say that these were the only copies known to be extant, but contented himself with pointing out that the book was not *introuvable*. But, some years later, when he himself brought out a new reprint of the *Essays*, he stated in the preface that the three copies, to which he had drawn attention in 1884, were the only copies that he knew of: "ces trois exemplaires sont les seuls que je connaisse".[10]

It seems that Dezeimeris knew of the existence of another copy in the Bibliothèque Municipale de Bordeaux[11], and Maurice Petit used this in publishing a further reprint of the *Essays* in 1907.[12]

When the present writer published in 1951 the first facsimile reprint of the original edition of 1630, he was able to record the existence of seven copies, those in the Bibliothèque Nationale, the Bibliothèque Mazarine, the Bibliothèque du Conservatoire National des Arts et Métiers, the Bibliothèque de la Ville de la Rochelle, the Bibliothèque Municipale de Bordeaux, the British Museum, and the Smithsonian Institution, Washington. The last is a duplicate sold by the British Museum in 1787.[13] None of these copies gives any indication of provenance or of former ownership.

Since the publication of this reprint, the writer has located five further copies of the original edition of 1630. Two of these are preserved in the Bibliothèque Sainte-Geneviève, Paris. One of these has some marginal notes in ink on two pages; and, although it is known that Mersenne possessed a copy of the *Essays*, these marginal notes do not appear to be in his hand. The other copy in this library has some pencil markings opposite various passages. Neither copy gives any indication of provenance or former ownership.

Two further copies were located in the Bibliothèque de l'Arsenal, Paris, but again there is no indication of former ownership although there are some words and figures written on the fly-leaf or title-page in both copies.

The most interesting copy that rewarded this search was that located in the Bibliothèque de la Faculté de Pharmacie, Paris. On the leaf facing the title-page was the inscription in black ink "exemplaire sacrifiée par le S^{r} Gobet à mon

[9] P.-P. Dehérain, *Rev. Sci.*, 1884, **7** (iii), 351.

[10] Edouard Grimaux, *Essais de Jean Rey* etc., Paris, 1896, pp. 10–11.

[11] See p. 175 of the work mentioned in footnote 12.

[12] Maurice Petit, *Essais de Jean Rey* etc., Paris, 1907.

[13] Douglas McKie, *The Essays of Jean Rey. A facsimile reprint of the original edition of 1630 with an Introduction*, London, 1951, p. xi.

insu pour la Réimpression". It thus appears that Gobet had used de Villiers's copy without the owner's permission and marked it for use by the printers when setting up the reprint of 1777, although, as we have already noted, he thanked de Villiers for his kindness in "sacrificing" his copy. Gobet and de Villiers seem to have had different ideas about sacrifice. On the same leaf is written in red ink in another hand "les pages 143 & 144 sont refaites à la main": this seems to have been written originally in black ink and the words have been retraced in red with the exception of "à la main". Below this is written "Exemplaire de M. de Villiers, mentionné dans l'Avertissement qui se trouve en tête de l'édition de Gobet. (Voir page 158 de l'edition de Maurice Petit.)". The title-page shows the editorial markings made by Gobet. In view of the interest of this copy, the title-page and the page facing it are reproduced here, as Plate IV. The reference to Petit's reprint cannot have been inserted before 1907, but, so far as the writer is aware, attention has not hitherto been drawn to the existence of this copy: the reference to Petit's text is merely to the text of Gobet's *Avertissement* there reprinted. With this copy are bound also the re-drawn and re-engraved illustrations for pp. 34 and 45 of the original edition.

The author's thanks are due to the Librarian of the Bibliothèque de Sainte-Geneviève, of the Bibliothèque de l'Arsenal and of the Bibliothèque de la Faculté de Pharmacie, Paris, for their help in tracing these five further copies of Rey's *Essays* and also to the many other librarians who regretted that no copy of this rare book was included in the collections in their care. He also wishes to express his thanks to the Bibliothècaire en chef de la Faculté de Pharmacie for permission to reproduce the title-page of de Villiers's copy of the *Essays*.

EGG SYMBOLISM IN ALCHEMY

By H. J. Sheppard

The Origins of Egg Symbolism

Though of prime importance in alchemy the Egg symbol was by no means confined to that art. Of great antiquity, it probably appeared for the first time in the many creation myths of the countries in which the first great civilizations emerged[1]; it occurs, for example, in several forms as a World Egg in the mythologies of Egypt, where alchemy itself was later to crystallize out of an amalgam of early technology, philosophy and Gnostic beliefs.

The similarities between many of the creation myths so intrigued mythologists that they made frequent attempts to trace their origins to a single country, though it cannot be said that these efforts were very successful. Comparative mythology is an amorphous subject, based upon racial and lingual classifications which hang together by slender threads, and Lobeck[2] was probably near the truth when he said of a common origin for the World Egg, "quaerere ludicrum est". The racial migrations which occurred in proto-historic times are in most cases conjectural, though Guha has shown convincingly that the population of parts of India by the early Proto-Australoid race from the Mediterranean was responsible for the occurrence today of features which are not common to other areas of the sub-continent—features such as totemistic beliefs and creation myths involving the World Egg[3]. Thus, elements of uncertain but great antiquity (pre-4000 B.C.) eventually became distorted or transformed into the mythical forms met with today in the Sanskrit *Puranas* and in popular Hindu folklore. From India the Proto-Australoid race moved further east to Melanesia and Polynesia[4], where we find also the myths of creation from an Egg.

Linguistic researches, too, point to the same movement eastwards from the Mediterranean, for Przyluski has traced the movement of the Austric language along the path followed by the Proto-Australoids[5]. But to infer in general that the World Egg had a single origin in the eastern Mediterranean would be unwarranted, for it can hardly account for the presence of the Egg in the myths of those other countries more widely separated and unrelated ethnically.

[1] A careful search among the mythologies of many countries has shown that the World Egg is prominent in the cosmogones of: Greece (Orphic sources), Egypt, Phoenicia, Yemen, Iran, India, Japan, Polynesia, Melanesia, Peru and Finland. This list may not be exhaustive.

[2] C. A. Lobeck, *Aglaophamus*, Leipzig, 1829, I, 473.

[3] *vide* S. K. Chatterji, The Vedic Age (*History and Culture of the Indian People*, Vol. 1), London, 1951, 151.

[4] *Ibid.*

[5] *Ibid.*; also Przyluski, "Emprunts Enaryens en Indo-aryen", *Le Monde Oriental*, Uppsala, 1934, XXVIII, No. 140.

The origins of primitive symbolism are better sought in the functioning of the primitive mind. Given the same simple surroundings and the same undeveloped mentality, the human mind, like the body, must have everywhere passed through similar stages of development. There seems to be no valid reason, then, why primitive men in different lands should not have evolved the same theories concerning the origin and the working of the universe. The explanation lies in the formulation of beliefs; true belief rests upon perception or upon inferences verified by perception, whereas false belief seems to depend upon imagination. From earliest times "picture-thinking" has been of inestimable value in aiding man to comprehend what cannot be reproduced as precepts but only imagined by constructing a picture out of concepts. Reason expresses itself here by imagination; and in the comprehension of the cosmic process imagination seized upon the creative process commonly observed within the animal world. By this means the World Egg most probably arose as a universal symbol of creation.

With the elaborate alchemical symbolism of later times the process of adoption was a complex one. The formulation of true symbols, as distinct from mere signs, is attributed by Jung to the "collective unconscious", that part of the unconscious mind which has been progressively conditioned by the impressions and experiences received by our fore-runners[6]. As a result of this conditioning, the unconscious mind projects primordial images, or archetypes, which are manifested as symbols appearing in dreams or in hallucinations; thus, the Philosopher's Egg of alchemy becomes a symbol of the primordial chaos out of which the living world emerged. In the words of Jung[7], it is "the chaos apprehended by the artifax, the *prima materia* containing the captive world-soul. Out of the egg—symbolized by the round cooking-vessel—will rise the eagle or phoenix[7a], the liberated soul, which is ultimately identical with the Anthropos who was imprisoned in the embrace of Physis". Regarded psychologically, then, the Philosopher's Egg takes its place in an interpretation of alchemy as a symbolic redemption of the soul of man according to Orphic-inspired Gnostic conceptions of regeneration.

However, in alchemy the Egg symbol occurs in such different forms and contexts that in the early texts, at any rate, it was probably a conscious representation of an egg, i e. in the terminology of Jung, was a sign—a representation of the real thing. In later works only would it appear that a true symbol arose by the psychological projection described.

[6] C. G. Jung, *Contributions to Analytical Psychology*, London, 1928, 276; an outline of Jung's psychology is given by F. Fordham, *An Introduction to Jung's Psychology*, London (Pelican Books), 1953, pp. 23 ff.

[7] Jung, *Psychology and Alchemy*, London, 1953, 193.

[7a] *Ibid. cf.* Fig. 98 (taken from the 15th century Codex Palatinus Latinus 412, Wynandi de Stega, *Adamas colluctancium aquilarum*) depicting "the philosophic egg whence the double eagle is hatched . . ."

Stages in the Manifestation of the Symbol

Throughout the long history of alchemy there appear to be three distinct stages of development of the symbol, each succeeding form gathering to itself greater complexity of expression and meaning. These phases are, in order of appearance:—

(i) A simple literal expression, accompanied, if at all, by only the simplest pictorial representation.

(ii) The fashioning of an Hermetic Vessel into a form indicative of its gestatory function.

(iii) A more complex pictorial representation of the Egg, symbolic of the mystical aspects of the Work. This form of imagery is confined almost entirely to the later adepts and, insofar as the Hermetic Vessel is concerned, is divorced from practical considerations.

In the descriptions of these stages which follow it should be realized that each stage retained and co-existed with previous ones.

Literal Symbolism

Early Hellenistic alchemy provides abundant examples of this type[8]; in most cases a parallel is drawn between the parts of the Egg and the ingredients of the Work. The Egg had various arbitrary denominations: to some it was the image of the world, to others stone of copper, stone of Armenia, stone of Egypt, etc. Again, the shell was likened to the earth or to various metals, while the designations of the contents were equally numerous and diverse. Thus, the white was called gum, fig-juice, tithymal juice and other vegetable notations; and the yellow likened to Attic ochre, mineral of hard copper, Cilician saffron, etc. All these materials form but a small part of the many substances cited, some of which defy positive identification. A summary of some of them, with their modern names, has been given by Sherwood Taylor in the paper noted below[9].

We see an early example of literal symbolism in Zosimos' text, *The Nomenclature of the Egg is the Mystery of the Work*, in which the Egg is likened to the Earth and, not unnaturally, regarded as containing the "elements"[10]. Here we have the Egg as a primitive emblem of generation endowed with Greek conceptions of elementary matter; later it becomes complicated by the assimilation of other constituents elaborated by the writers.

[8] The designations given will all be found in M. Berthelot, *Les Origines de l'Alchimie*, Paris, 1885, pp. 24, 115, 125, 337, 343, 348, 350, 351, 354. Most of these are references to original sources published in his *Collection des Alchimistes Grecs*, Paris, 1888.

[9] F. S. Taylor, "A Survey of Greek Alchemy", *J. Hellenic Stud.*, 1930, L, Part 1, 123.

[10] Berthelot, *Collection*, I, iv, 20.

The *Chrysopoeia* of Kleopatra consists of a single page portraying apparatus and symbols[11], one of which, a circle, may represent the Egg or cinnabar, the latter being a term applied at times to substances other than mercuric sulphide. Assuming that the symbol applied to mercuric sulphide, it is difficult to resist the light-hearted suggestion that this arose out of the ability of cinnabar to yield upon heating small globules of mercury which, by coalescence, formed egg-like droplets! However, the assimilation of the symbol to cinnabar most likely arose, as Sherwood Taylor suggested to the writer, from the fact that cinnabar itself is composed of the yellow (sulphur) and the white (mercury) like the egg—which, again, corresponds to gold and silver.

In the *Letter to Petesios*, attributed to Pseudo-Ostanes (first two centuries A.D.?)[12], are given the practical details for preparing a "divine Water". The author, who resorts to allegory, warns the reader of the true intent of his recipe by placing alchemical signs above words which must be interpreted in a different sense from the literal. Thus, the probable method of preparing the Divine Water is as follows: "Taking the eggs of the serpent of oak (sign of mercury placed above) which dwells in the month of August on the mountains of Olympus (sign of cinnabar placed above) or Libanus or Taurus, put them when they are fresh into a glass vessel . . .". This evidently refers to the preparation of mercury from cinnabar and implies the identity of the Egg and mercury. The same idea is expressed in a Cairo MS. referred to by Stapleton[13], wherein Zosimos remarks, "They (the alchemists) have called this secret 'The Egg': but all of them (really) mean 'Mercury'."

Earlier in this Cairo MS. we learn, too, that during his visit to Egypt, Ostanes informed the Egyptians of the eastern belief that eggs contained the same essential nature as the brain of the pig, regarded by Egyptians as the First Principle of the Work[14].

This identity of the Egg with the ingredients of the process is shown again in the description which Sherwood Taylor gave of Zosimos' use of real eggs in distillation[15]. The products described correspond closely to those actually obtained in such a distillation: firstly, a clear distillate called "rain-water"; secondly, a pale golden liquid, "oil of radish"; and finally, a dark yellowish-green liquid, "castor-oil". As Sherwood Taylor suggested, the probable aim was the extraction of the life-giving *pneuma*, in addition to the golden sulphurous liquids which could be used for tingeing other materials.

[11] *Ibid.*, *Introduction à l'Etude de la Chimie des Anciens et du Moyen-Age*, Paris, 1889, pp. 131 ff.

[12] *Ibid.*, *Collection*, II, pp. 261, ff.; also J. Bidez, F. Cumont, *Les Mages Hellénisés*, Paris, 1938, II, Part 2, 334.

[13] H. S. Stapleton, "The Antiquity of Alchemy", *AMBIX*, 1953, V, i and ii, 34.

[14] *Ibid.*

[15] F. S. Taylor, *The Alchemists*, London, 1951, pp. 44–5.

The Hermetic Vessel

Following the primary conception of the rebirth of matter from the Egg, there came the all-important task of bringing about *in vitro* that which theory attributed to nature. For this purpose the apparatus was of no less significance than the materials themselves; the creation analogy was carried a stage further by the employment of a vessel of truly symbolic form—a *vas mirabile*. From the diagrams in the Greek manuscripts it would appear to be a vessel of thick glass or earthenware with a round bulb and a short neck[16]. In such a form it persisted throughout the period of Muslim alchemy, finally to be portrayed symbolically in the later pictorial symbolism illustrating the *magnum opus*.

Later Pictorial Symbolism

With the transition of alchemy from a dual mystico-practical craft to the predominantly esoteric quest referred to as Hermetic Philosophy there emerged in western Europe a wealth of pictorial symbolism. The main concepts of the earlier alchemists were retained, but their expression was carried to such extravagant lengths as to make it evident that little practical significance could be placed on them. Nevertheless, most of the representations were beautifully executed designs in which the Philosopher's Egg featured prominently, both as the "creative point" and as the Hermetic Vase.

Among the finest examples of the latter are those which occur in *Splendor Solis*, attributed to Salomon Trismosin, a work which "is divided into seven parts, in which is described the hidden mystery of the old philosophers . . ."[17]. Of the twenty-two magnificent illustrations in the text, seven depict a pear-shaped Hermetic Vase; the accompanying description is given in the modern version which has introductory notes by "J.K."

Association with the four-element theory occurs in the fifth parable, wherein "The Philosophers take for example an Egg, for in this the four elements are joined together. The first or the shell is Earth, and the White is Water, but the skin between the shell and the White is Air, and separates the Earth from the water; the Yolk is Fire, and it too is enveloped in a subtle skin, representing our subtle air, which is more warm and subtle, as it is nearer to the Fire, and separates the Fire from the Water. In the middle of the Yolk there is a FIFTH ELEMENT, out of which the young chicken bursts and grows.

Thus we see in an egg all the elements combined with matter to form a source of perfect nature, just so as it is necessary in this noble art"[18].

[16] *vide* C. J. S. Thompson, *The Lure and Romance of Alchemy*, London, 1932, 114.

[17] *Splendor Solis*, Harley MS. 3469 (Brit. Mus.) dated 1582; the English edition, with notes by J.K., was published in London, N.D. (1921).

[18] *Ibid.*, pp. 32–33.

The source from which this parable derives is evidently the *Turba Philosophorum*, in the early discourses of which the philosophers' views on the relationship between alchemy and cosmogony are illustrated by means of the Egg. In a recent study on the origin of the *Turba* Plessner[19] has succeeded in identifying the first nine philosophers mentioned with nine pre-Socratics, whose cosmogonical theories are known from the existing doxographies.

Early in the *Turba* we learn from Iximidrus (Anaximander) that "fire and water are enemies between which there is no consanguinity, for the fire is hot and dry, but the water is cold and moist. The air, which is warm and moist, joins them together by its concording medium; between the humidity of water and the heat of fire the air is thus placed to establish peace"[20]. This, as will be seen, explains the separation of the Yolk (Fire) from the White (Water).

The assembly approves of this, and Exumdrus (Anaximenes) then discusses the nature of Air, following which Anaxagoras (same) deals with Pietas and Ratio (Density and Proportion). Then Pandulfus (Empedocles) is called upon for his views: "I signify to posterity", he declares[21], "that air is a tenuous matter of water, and that it is not separated from it. It remains above the dry earth, to wit, the air hidden in the water, which is under the earth. If this air did not exist, the earth would not remain above the humid water". Thus we see how the Shell (Earth) is separated from the White (Water).

Pandulfus (Empedocles) summarizes the discussion as follows: "The province of the air is, therefore, to fill up and to make separation between diverse things, that is to say, water and earth, and it is constituted a peace-maker between hostile things, namely, water and fire, dividing them, lest they destroy one another"[22]. The assembly requests an example, whereupon he proceeds to illustrate the findings by reference to the structure of an egg—in terms almost identical with those which we find in *Splendor Solis*[23].

It is difficult to connect the views of Iximidrus and Pandulfus with those of the true pre-Socratics Anaximander and Empedocles. The "four-element" theory was first propounded as such by Empedocles; and Anaximander admittedly opposed the "hot" and the "dry" to the "cold" and the "moist", though these he conceived as separating out from a substrate, the Non-Limited (Apeiron). The separative action of the Non-Limited occurred by a vortical movement, leaving the "cold" at the centre and the "hot" at the periphery of the vortex.

[19] M. Plessner, "The Place of the *Turba Philosophorum* in the Development of Alchemy", *Isis*, 1954, XLV, Part 4, No. 142, pp. 331–8.

[20] *Turba Philosophorum*, edited by A. E. Waite, London, 1914, 5.

[21] *Ibid.*, 10.

[22] *Ibid.*

[23] *Ibid.*, pp. 11–12.

The "cold" by this time "consisted of a layer of Air, and inside it was the Earth. At first this so-called Earth was all Wet, but by the action of the Hot drawing up the moisture, it had gradually been dried; the Wet which remained in the hollows of the earth is the sea. . . . Thus there came into being four rings: Hot (Fire), Cold (Air), Wet (Water), Dry (Earth), the ring of water being broken"[24]. Contrast this with the structure of the Egg as it appears in the *Turba* (Figs. 1 and 2).

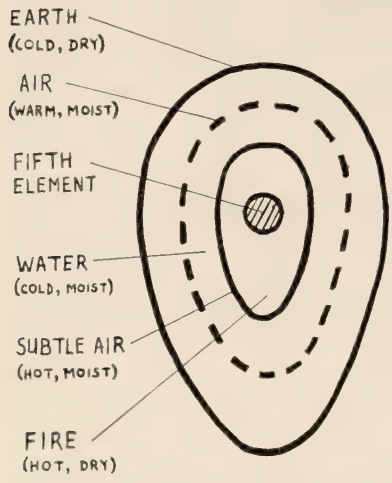


FIG. 1.
The Elements in the Egg
(*Turba*)

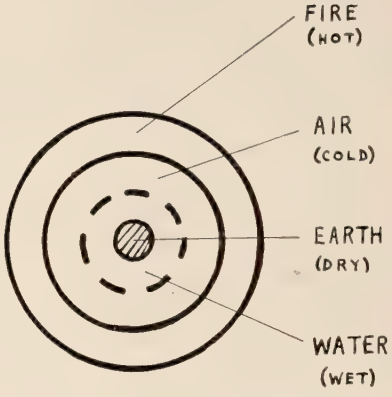


FIG. 2.
The Elements in the Cosmos
(Anaximander)

But the sense in which Pandulfus uses the idea of separation is that of a separating medium, something interposed between opposites to keep them apart. Dynamic separation, or "separating out", occurred, according to Empedocles, through the action of "Strife"; once separated out by this means air could maintain its position by the exertion of pressure—and this can be the only explanation of the ideas expressed in the *Turba*.

There is thus some confusion in the use of pre-Socratic notions in the *Turba*. As Plessner says[25], this has come about from the fact that the so-called pre-Socratic philosophy has been derived, not from original texts, but from an alchemical source in which cosmology has been adapted to illustrate alchemical doctrines. And this source is evidently a work referred to earlier by Berthelot—a doxographic text of Olympiodorus in which the ideas of nine philosophers are compared with those of the alchemists[26].

[24] K. Freeman, *Companion to the Pre-Socratic Philosophers*, Oxford, 1953, 59.
[25] *Op. cit.*, 335, 337.
[26] Berthelot, *Collection*, II, pp. 81 ff.

There are many interesting examples of the Egg as the Hermetic Vase; the *Commentariorum Alchymiae* of Libavius[27] represents the Vase incorporating pictorially the stages of the *magnum opus*. An illustration and description of this will be found in Professor Read's *Prelude to Chemistry*[28].

Contemporary with Libavius was the German Michael Maier who, more than any other alchemist, was responsible for the strangest collection of mystical symbolism, much of which was couched allegorically in the figures of classical mythology. The present writer has discussed earlier in this Journal[29] the representation of a swordsman taking aim at the Egg with his sword; it is intended to symbolize the production of the Philosopher's Stone from the Egg as a result of the application of heat (symbolized by the sword) and recalls a similar theme in the *Tractatus Micreris*, wherein an allegory attributed to Ostanes requires that the Egg be pierced with a fiery sword[30].

The *magnum opus*, the alchemical process resulting in the production of the Philosopher's Stone, lent itself readily to a variety of symbolic expressions of the Egg or Vase. The stages of the *opus* are well known and derive from the series of colour changes observed in Hellenistic alchemy[31]: the initial ingredients when subjected to heat assumed a black state (*melanosis*)—the *prima materia*—which was then followed by whitening (*leukosis*), then yellowing (*xanthosis*) and, finally, reddening (*iosis*). By the late Middle Ages these stages had acquired a new significance. In Hellenistic alchemy it must have been recognized that there was a symbolic likeness to the experiences of a participant in the rituals of the ancient mystery religions; the neophyte witnessed a ritual suffering, death and resurrection of the god, which, in later Christian symbolism, was transferred to the passion, death and resurrection of Christ. In the alchemical *opus* the initial application of heat represented the passion and resulted in mortification, symbolized by *melanosis*, or *nigredo*; resurrection (*leukosis*, or *albedo*) followed a baptism which on the alchemical plane corresponded to washing. The goal, redemption, was then attained; though in the late texts the alchemical process proceeded with or without *xanthosis* to the highest stage, *iosis*, generally termed the *rubedo*, which resulted from an intensification of the applied heat. All of this is of profound psychological significance, a discussion of which must be omitted here; it is discussed in great detail by Jung in his study *Psychology and Alchemy*[32].

[27] Andreas Libavius, *Commentariorum Alchymiae*, Frankfurt, 1606.

[28] J. Read, *Prelude to Chemistry*, London, 1936, 217 and Plate 40.

[29] "Gnosticism and Alchemy", *AMBIX*, 1957, VI, ii, 100.

[30] *Tractatus Micreris suo discipulo Mirnefindo*, Theatrum Chemicum, Vol. V (Strasbourg, 1622), XXVII, pp. 90 ff.; *vide* also, J. Bidez, F. Cumont, *Les Mages Hellénisés*, II, Part 2, 355.

[31] *vide* A. J. Hopkins, *Alchemy, Child of Greek Philosophy*, New York, 1934.

[32] First published as *Psychologie und Alchemie*, Zurich, 1944.

In the pictorial representations of the *magnum opus* the proximate materials were placed in the Egg, or Vase, which was depicted in various ways to symbolize the union of opposites. This union was best expressed in terms of sexual dualism, opposite principles being depicted often as King (male—sophic sulphur) and Queen (female—sophic mercury). Their conjunction might be regarded as a marriage, in which case the container was a palace "constructed by the hands of many craftsmen . . . the king and his spouse must be quite naked when they are joined together . . . that their seed may not be spoiled by being mixed with any foreign matter"[33].

But this compulsory confinement would to some writers best be symbolized as imprisonment; the bride and bridegroom "were shut up for ever in a close prison, which, however, was as pellucid and transparent as glass", the narrator informs us in *The Golden Tract*[34]. Or, as in the *Philosophia Reformata* of Daniel Mylius, the conjunction takes place within a glass tomb, the conjoined bodies becoming an hermaphroditic corpse which blackens and putrefies[35].

From the conjunction of opposites was born the hermaphrodite or "rebis" (two-thing), which, in the diagram from *Viatorium Spagyricum*[36], is seen standing on the winged globe of chaos (the Egg), accompanied by the seven planets and the dragon.

In the portrayal of the *magnum opus*, alchemical symbolism attained its richest expression. As we have seen, the Egg played a variety of roles throughout the long history of alchemy; from a mere sign, of practical significance, it soon evolved into a true symbol, psychologically formulated, and appropriately took its place among the symbols of a quest which, too, had evolved from a practical craft into a predominantly esoteric quest.

I am indebted to my friends K. G. Brocklehurst, M.A., and B. W. Young, M.A., for assistance in the presentation of this paper; the former kindly executed Figs. 1 and 2, while the latter willingly, as always, provided me with translations of several passages from some of the Greek texts quoted.

[33] A. E. Waite (ed.), *The Hermetic Museum, Restored and Enlarged*, London, 1893, 328.

[34] Waite, *op. cit.*, pp. 46 ff.

[35] J. D. Mylius, *Philosophia Reformata*, Frankfurt, 1622; *vide* F. S. Taylor, *The Alchemists*, plate VI and pp. 153–6.

[36] Herbrandt Jamsthaler, *Viatorium Spagyricum*, Frankfurt, 1625. The emblems in this work were adopted from J. D. Mylius, *Philosophia Reformata*, or from Daniel Stolcius, *Viridarium Chymicum*, which incorporated many of the emblems of Mylius (*See* J. Read, *Prelude to Chemistry*, London, 1936, Chap. VII, *passim*).

RESEARCH SOURCES IN ANCIENT MESOPOTAMIAN CHEMISTRY

By Martin Levey*

It was after the middle of the fourth millennium B.C. that writing was invented in Mesopotamia. At this time, planned large scale irrigation emerged to influence the entire economy. Imposing ziggurats were constructed. Dyeing, spinning, weaving, tanning, agriculture, and other technologies approached an elevated level scanning the horizon for further advances[1]. Society thus became more and more complex to keep up with developing inventions and discoveries. Very rapidly, a more elaborate tablet literature was developed describing various facets of this part of the ancient world.

Ancient chemical technology, however, is sparsely described in the tablet texts. In the transmission of ancient science which, of necessity, involved the productive and applied branches, one should, to a large extent, expect to find a continuity of processes and methods over a long period of time. Unfortunately for the fullest comparative study, too little is as yet known of ancient scientific practices partly because of the widespread illiteracy of the ancient worker in technology or his desire to maintain the secrecy of his knowledge in self protection. Description of actual scientific procedures is not encountered on a grand scale until the Alexandrian period and more fully later on in the Golden Age of the Muslims. Throughout this long period of time, from the Sumerians to the Muslims, technical knowledge was carried forward continuously, for the most part, by the manufacturers of products used in the day to day lives of the people.

Nevertheless, knowledge of the history of Mesopotamian chemical technology is derived from a number of different sources. The most important of these are, 1. contemporary literature, 2. artifacts, and 3. related writings of succeeding civilizations.

Contemporary evidence may be obtained directly from such sources as Egyptian hieroglyphic writings, Sumerian, Akkadian and Hittite cuneiform tablets, and further afield, from the Phoenician and Ugaritic literatures. The Sumerian and Akkadian works contribute much to our understanding of their chemistry and technology. This is not, generally, done directly but the data must be gleaned from many types of unrelated writings.

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[1] T. Jacobsen, in *Before Philosophy*, by H. and H. A. Frankfort, J. A. Wilson and T. Jacobsen, Harmondsworth, 1954, pp. 137 ff.

For example, mythological literature is at times helpful. In the Ugaritic literature, there is reference to the smith god, the god of the handicrafts:

"Hyn goes to the bellows
In the hands of Hss are the tongs
He casts silver
He casts gold
He casts silver by thousands (of shekels)
Gold he casts by myriads
He casts hym and tbth
'Il's crown of two myriads
'Il's crown studded with silver
Adorned with red gold.[2]"

A magical text contains interesting information about the tanning process. "You will steep the hide of a young goat with milk of a yellow goat and with flour. Apply fine oil, ordinary oil, fat of a pure cow. You dissolve the alum in pressed wine and fill the surface of the hide with gall nut extract (grown) by Hittite gardeners[3]." This process is known today in the Near-East where the skins are made into bags, are filled with the tanning solution and then thrown into vats of the same solution.

Although glass beads belonging to the fourth millennium B.C. have been unearthed at Ur, our oldest technical literature in this field of technology is no earlier than the 17th century B.C.[4] Together with another glass text of 1,000 years later[5], both of which are still imperfectly translated, these are among the very few tablets devoted to purely technological aspects of ancient Mesopotamian culture.

Further, medical texts afford much knowledge of many chemical materials, their preparation and uses as well as the types of chemical operations utilized. From a Sumerian prescription of ca. 2000 B.C., one reads:

"Purify and pulverize the (skin of a) water snake; pour water over the *AMAMASHDUBKASKAL* plant, the root of myrtle, pulverized alkali, barley, and powdered fir resin. Boil. Let its (extracted) liquid be decanted. Wash it (the ailing organ) with the extract. Rub tree oil on it. . . ."

From the same tablet, another prescription reads:

"Purify, pulverize the . . . of a cow. Pour water over a branch of myrtle, a 'star plant', the root of the *AB* tree, dried apple, and *IB* salt. Boil. Let its

[2] C. H. Gordon, *Ugaritic Literature*, Rome, 1949, p. 28.

[3] H. C. Rawlinson, *A Selection from the Miscellaneous Inscriptions of Assyria*, British Museum, London, 1891, IV, text 28, 3, rev. 4; F. Thureau-Dangin, *Revue D'Assyriologie*, 1920, 17, 27.

[4] C. Gadd and R. C. Thompson, *Iraq*, 1936, 3, 87–96.

[5] H. Zimmern, *Zeit. f. Assyriologie*, 1925, 36.

liquid be filtered off. Wash it with the filtrate. Let potassium nitrate and the . . . plant be added.[6]"

This text demonstrates that botanical, zoological and mineralogical sources were exploited by the Sumerians to derive the drugs. The materia medica of the ancient Mesopotamians included substances which presuppose broad acquaintance with many types of chemical operations. Elaborate procedures are implied in the text for the preparation of the mentioned materials. To take one example, in order to win the tree oil from its source would involve a great number of varied operations and different kinds of apparatus[7]. In addition to pulverization, infusion, aqueous and oil extraction, filtration[8] is also seen to have been practised to separate the organic materials from the aqueous extract of the decoction.

An Assyrian prescription is of interest because of the variety of materials used:

"If a man (is sick) from blowing of the wind, the heat of the day . . ., for his recovery, ten shekels of opium (?), ten shekels of Asa foetida . . ., ten shekels of mint, ten shekels of *AZAG.PAD* salt, ten shekels of saffron, ten shekels of pine-turpentine, ten shekels of fir-turpentine, ten shekels of castor oil, ten shekels of salt, ten shekels of gall nut, ten shekels of oleander, . . ., ten shekels of Ferula communis, ten shekels of cedar, ten shekels of myrrh, ten shekels of Acorus calamus, five shekels of wormwood, five shekels of balsam, five shekels of sagapenum, five shekels of Anacyclus pyrethrum. These 25 drugs and aromatics together thou shalt pound and filter. Thou shalt take *kurunnu* beer, rose-water, and strong vinegar—these powders therein, thou shalt put. . . . In the morning, thou shalt take them out, cool them, filter. Honey and refined oil thereon thou shalt put. . . .[9]"

Economic tablets such as lists of stores, provisions, bills of sale, and receipts are particularly interesting. An economic text pertaining to silver goes:

"Two rings of silver, each five shekels in value, weigh 9 5/6 shekels minus 3 grains, its 'eating up by fire' equals 60 grains and its 'quantity left over' equals 23 grains.[10]" Taken together with other evidence, the conclusion here must be that the first operation was a smelting in which most of the probable lead impurity was oxidized to litharge which was volatilized at a medium temperature

[6] M. Levey, *J. Chem. Ed.*, Aug., 1954.

[7] R. C. Thompson, *Dict. of Assyrian Chem. and Geology*, Oxford, 1936, p. 7.

[8] H. Sigerist, *A History of Medicine* I, New York, 1951, p. 489.

[9] R. C. Thompson, *Revue D'Assyriologie*, 1929, 26, No. 87, col. II; *cf.* also *ibid.*, 1934, 31, 1–29.

[10] L. Legrain, *Ur Excavation Texts Business Documents of the Third Dynasty of Ur*, Phila., 1937, 392, 1–5.

by a mild air blast, perhaps by opening of the muffle door. The second operation was probably a cupellation in which a small quantity was left in the pores of the cupel.

In the case of gold refining, for the temple records, a tablet reads:

"Two minas 2 shekels of gold were put into the furnace, 10½ shekels of them were lost in the furnace, 1 mina 5½ shekels of dark gold came out of the furnace[11]."

Lexical lists of drugs, spices, minerals, and other materials, objects, and phrases relating to them with synonyms and equivalents in much the style of a dictionary have been discovered. These lists, most of which are in Akkadian and Sumerian, sometimes in both Sumerian dialects, shed further light on the extent of Mesopotamian chemical knowledge.

Part of an interesting list gives in the following order, "gold color, orpiment, white alum powder, black powder, alum, and gypsum[12]." These substances listed are used in the decoration of leather. The alum is mentioned here since it is used in color mixtures to further treat the leather at the point of application of the paint[13]. Another list contains names of different alloys of gold: "gold, green gold, fine gold, white gold, red gold, superfine gold, refined gold[14]".

In Egypt, no one had thought even until Roman times of listing groups of related hieroglyphs although the writing was very complicated. Nor are there any sign or word lists in the Cretan, Hittite or Indic scripts. In the third millennium B.C., the Sumerians had many lists systematically arranged. They would start with simple ideas as *DUK*, "container", then give all kinds of containers, also containers with certain substances and objects inside them, going from the simple to the complex. To the older pictographic lists, the Sumerians gradually added syllabic signs as the writing changed.

It is difficult to think of the lists as scientific since many of them were built on the idea of appearance, type of material, and their uses. Their uniqueness lies in the fact that no other people put its learning into thsi form. How oral teaching and elaboration expounded and complemented the lists is not known. The Sumerians made their last systematization at the end of the third millennium B.C. when the Akkadians were already the political masters in the region. Since Sumerian was a difficult language for them, the Akkadian speaking people found it convenient to make lexicographical lists as philological aids. They did not comprehend fully the attempt of the Sumerians at a unified world order.

[11] J. N. Strassmaier, *Inschriften von Nabonidus*, Leipzig, 1889 489, 1–4.,

[12] R. Nikolsky, *Documenty chozjajstvennoj otčestnosti drěvnejšej epochi chaldei*, Petersburg, 1908, 438, rev. 9.

[13] V. Crawford, *Babylonian Inscriptions in the J. B. Nies Collection*, IX, No. 80, *passim*; *cf.* also Clay, *Babylonian Expedition*, XIV, 63, 1.

[14] J. Bottero, *Revue D'Assyriol*, 1949, 43, 17; O. R. Gurney, *Sumer*, 1953, 9, 21–35; *Iraq*, 1949, XI, 131–142.

As far as is known, on the other hand, the Sumerians had no grammatical lists nor did they have an interest in the structure of their language. There was no need. This is further demonstrated in the fact that the Sumerians' ordered-lists of things did not include all parts of speech but only the substantive and substantival phrases. Only nouns and adjectives were included in the sign lists. The intention was thus to make an orderly list of the world of appearance and the material one.

In the *ḪARRA-ḫubullum* list, made up by the Akkadians, for example, minerals are listed together with hides and chemical materials for some as yet unknown reason in tablets 10–12 and 16. The *nabnîtu* "form" list gives under one word all variations of a certain Akkadian word root together with their Sumerian meanings. In this list, among the words listed are those for the different parts of the body going from head to foot. In the lists, there are lacking methods of making and compounding chemical substances[15].

The rich historical, ritual, and omen literatures cite a great number of chemicals in their practical application e.g. the salting of a corpse for its preservation or perfumes and oils for use as incense, lavation, booty, prognostication, and many more. An example of a text which mentions cleansing agents is:

"May the tamarisk whereof the tops grow high cleanse me; may the date palm which faces every wind free me; may the *mastakal* plant which fills the earth clean me; may the pine cone which is full of seed corns free me[16]."

In ancient Mesopotamia, there was very little stone and so one would expect very few large pictorial representations of a technical nature. The glytic art of Mesopotamia, however, is particularly rich not only from the artistic point of view but also from that of the historian of chemistry and technology. Various types of ovens, vessels, diverse tools and operations of a chemical nature have been depicted on cylinder and other seals.

On the other hand, much evidence has come from metal and clay objects and other inorganic artifacts which were in more or less common use in ancient times. Much of the apparatus of the ancient chemical workroom has been reconstructed. Heating vessels, filtration apparatus, separatory vessels, stills, sublimatories, and extraction apparatus as well as many other types of equipment have been recognized in the artifacts discovered[17].

Chemical analysis of the artifacts is becoming increasingly important in a field where the ancient chemical technical literature is so meager. This involves the latest methods of microtechniques to protect the artifact. For example,

[15] A. Poebels, *Grammatical Texts*, Phila., 1914; S. Langdon, *Journ. Roy. Asiat. Soc.*, 1931, 840 ff.; A. Deimel, *Schultexte aus Fara*, Leipzig, 1923.

[16] K. L. Tallquist, *Assyrische Beschwörungsserie Maqlu*, Helsingfors, 1894, I, p. 21.

[17] M. Levey, *J. Chem. Ed.*, 1955, 32, 11.

together with Dr. J. E. Burke of the General Electric Co., the author studied ancient bronzes which were analyzed by an x-ray fluorescence technique and the crystallographic structure was examined microscopically to see if the original cast grains had been disturbed[18].

Bronzes which are fully annealed give rise to grains which are equi-axed or equi-dimensional. In addition, they display many straight-sided bands. These are annealing twins that are produced only in worked and heated metals like copper and bronze. The axes which were studied, from Tepe Gawra and Tell Billa of 3450 B.C. to 2000 B.C., contained tin when the shapes were complicated so as to facilitate casting. The increase in strength by the addition of tin was relatively unimportant. Microscopic study showed that simple shapes were cast in open moulds and subsequently hammered to the final shape.

Much work still remains to be done in the archaeological chemistry of Mesopotamia, particularly in the case of metals, glass, and ceramics. Under the direction of the author, a Committee on Archaeological Chemistry, of the History of Chemistry Division of the American Chemical Society, has been organized to further work in this field.

Finally, a very useful method has proved to be that of backward extrapolation. Beginning in the medieval period and going back in time from the Arabic, Latin, and Greek writings one may frequently predict what is to be found in the works written in the older Aramaic, Syriac, Hebrew, and Ethiopic. In turn these, when examined, shed light on Mesopotamian chemicals and chemical processes. A case in point is the method of tanning and leather decoration in use by the Arabs in the medieval period which is related to the processes in the Babylonian Talmud in Aramaic, and in turn very close to the Sumerian tablet literature on tanning and decorative procedures in leather work[19]. This is a method of attack useful for corroborative and exploratory purposes. When taken with the fossil witnesses of philological evidence an excellent check is often obtained.

For the most rewarding use of materials, the artifacts, literature, and evidence from contemporary and later civilizations must all dovetail for the greatest strength to overcome the difficulties inherent in studies going back to over 5000 years ago. Although the clay tablets on which the Mesopotamians wrote were able to resist corrosion and deterioration to a large extent, concealment of knowledge in an archaic technical jargon, drawbacks of dialectical differences, and the changing ideograms and grammars still present many uncertainties to the historian of ancient chemistry.

[18] M. Levey and J. E. Burke, *Chymia* V.

[19] M. Levey and M. Krek and H. Haddad, *Isis*, 1956, 47, 239–243.

LETTERS TO THE EDITOR

FAHRENHEIT'S THERMOMETRIC SCALE

SIR,—By an ingenious manipulation of the numbers 32, 212, 180, Dr. Goldschmidt, (*AMBIX*, **6**, 107), succeeds in extracting a "coded message" from "Fahrenheit's" thermometric scale. Unfortunately, however significant these numbers may be for the present-day *Fahrenheit* scale, only the first played any part in *Fahrenheit's*. Fahrenheit did not take the boiling point of water as his upper fixed point, but the blood temperature of a man in good health, 96 degrees on his scale. The relevant numbers are therefore 32, 96, 64, not, as Dr. Goldschmidt supposes, 32, 212, 180. When Fahrenheit settled on his scale he was apparently unaware that water boiled at "a fixed degree of heat": he writes in 1724, (*Phil. Trans.*, **33**, 1724, 1), that he first learnt of this some ten years earlier through reading Amonton's account of his experiments; that three years later (*c.* 1717) he tested other liquids to see whether they behaved in the same way as water in this respect. Among the results of his experiments he gives the boiling point of water as 212 degrees on his scale, but he never adopted this as a fixed point.

Dr. Goldschmidt says it was the manifest "arbitrariness" of "Fahrenheit's" scale that led her to analyse it for any esoteric meaning it might conceal. Of course, on the face of it, the choice of 32 degrees for the freezing point of water and 212 degrees for the boiling point, or, as in Fahrenheit's case, 96 degrees for blood temperature, does seem arbitrary. In actual fact, however, Fahrenheit's scale was not devised by himself, but was a modification of one used by the Danish astronomer Rømer. We know this from a letter written to Boerhaave in 1729, discovered twenty-odd years ago in the Military Medical Academy at Leningrad (see Ernst Cohen and W. A. T. Cohen-De Meester: "Daniel Gabriel Fahrenheit", *Kon. Akad. Wet. Verhand.*, 1936, pp. 1–37, and my review of this monograph in *Annals of Science*, **2**, 1937, 133). According to this letter Fahrenheit visited Rømer in Copenhagen in 1708 and saw him preparing his thermometers by placing them first in a mixture of water and ice and then in warm water at blood temperature; the distance between the two points thus determined was halved, and a third point, the zero of the scale, marked off at this half-distance below the freezing point; the interval between the freezing point and blood temperature was divided into 15 degrees. On Rømer's scale, therefore, the freezing point was $7\frac{1}{2}$ degrees, and the blood temperature $22\frac{1}{2}$. Fahrenheit adopted this scale, but divided each of Rømer's degrees into four smaller parts, still, however, retaining the main division into $22\frac{1}{2}$ degrees. He adhered to this arrangement until 1717, when, as he says in the letter, to avoid the inconvenient fractions he replaced the division into $22\frac{1}{2}$ or 90 by a division of the interval between the zero and blood temperature into 96 degrees, the freezing point now becoming 32 degrees.

In case Dr. Goldschmidt should be tempted to look for concealed messages in Rømer's scale, it should be mentioned that recent researches by Louise

Diehl Patterson (*Isis*, **44**, 1953, 51) point to a definite link between Rømer's scale, back through Hauksbee's and the Royal Society standard, and Hooke's, (*Micrographia*, 1665, p. 38).

Finally, Dr. Goldschmidt says that "Fahrenheit claimed to have based the zero of his scale on the temperature of a mixture of salt and ice". The erroneous but long-accepted idea that Fahrenheit chose as his zero the lowest temperature obtainable by mixing water, ice, and sal ammoniac seems to be based entirely on statements in his first two papers in the *Philosophical Transactions* for 1724 (**33**, p. 2, pp. 78, 79). These statements, taken by themselves, do lend strong support to the idea, but when read in the light of our present knowledge of Fahrenheit's method of arriving at his zero, they become comparatively unimportant. For example, in describing the thermometers used in his experiments, Fahrenheit says (p. 78) the division of the scale rests on three determined marks, *tribus nititur terminis fixis*, referring, it seems to me, to the three standard points determined by the procedure described in the letter to Boerhaave, NOT to three "fixed points" (modern meaning) separately determined by experiment, a procedure which would almost inevitably lead to discordant results. Fahrenheit goes on to say that the first of these lies at the bottom or beginning of the scale and is attained (*acquiritur*) by a mixture of ice, water, and sal ammoniac: if a thermometer is placed in this mixture, the liquid (spirits of wine, or mercury) falls to the degree which is marked zero; he adds that the experiment succeeds better in winter than in summer. My rendering of the word *acquiritur* as "is attained", not "is found", is supported by Fahrenheit's use of the same verb in connection with the blood-temperature mark: he says that the third mark lies at 96 degrees; that the spirit expands to this degree if the thermometer is held in the mouth or under the arm-pit of a healthy man until it has perfectly attained (*acquisivit*) the heat of the body. Nowhere does Fahrenheit "claim" that his zero was determined from the mixture of water, ice, and sal ammoniac; in fact, since the eutectic point of ammonium chloride is about $-16°C$, the lowest temperature obtainable by such a mixture would be more than 3 degrees above Fahrenheit's zero, a fact which would prove very disconcerting when it came to marking the freezing point as 32 and the blood temperature as 96.

I am, Sir, etc.,

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REVIEWS

The Development of Titrimetric Analysis till 1806. By E. Rancke Madsen. Pp. 239. 10 fig. Copenhagen. G. E. C. Gad. Publishers, 1958.

"The history of analytical chemistry is still waiting for its author, and, in books or treatises especially dealing with the history of chemistry, the mention of analytical chemistry is usually very brief and confines itself to giving more or less the same, one feels tempted to saying traditional, but not always correct information". These words occur in Rancke Madsen's chapter on the purpose and scale of his work. It may be said that he has here made a contribution of exceptional value to that yet unwritten history of analytical chemistry, both in content and in method of approach.

Claims have been made that this or the other chemist was the "Father of Volumetric Analysis" (Lampadius, Mohr, even Dalton). Rancke Madsen finds that Descroizilles first described a general method, employing a common measuring apparatus for different types of titration, distinct from the reaction vessel.

Rancke Madsen gives this classification of analytical methods:

1. Isolametry: the sought component is isolated completely.
2. Normometry: the sought component is determined by comparison with known standards (e.g. colorimetry).
3. Titrimetry: the component is determined by its ability to participate in a chemical process.

He points out that although the present-day working analyst thinks of titrimetry in terms of reactions in solution, the broader definition does not imply necessarily that solutions are involved. By adopting this view he is able to show how the solution—volumetric method evolved (and it seems proper to say "evolved") from chemical practices which appear at first sight to have little to do with it. He connects these antecedents sufficiently with other analytical practices to suggest further work on other aspects of 18th century analytical chemistry.

It is well-known that Boyle knew a good deal about colour changes produced in vegetable juices by acids, alkalies and other substances, and Rancke Madsen gives examples of Boyle's sage anticipation of later titrimetric methods, but remarks that we must not take them as proposals, but may rightly regard them as germs. He attributes the first purely titrimetric method to Geoffroy, who adds alkali in solid form to an acid, takes cessation of effervescence as end point, and determines the quantities gravimetrically.

It is a pleasure to see justice done to the analytical work of Francis Home. His "Experiments on Bleaching" (1756) was of great importance in the progress of technical chemistry, even though its proposals were later outmoded by Berthollet's application of chlorine to bleaching. Home's work gives us a clear view of the practical chemist trying to use the limited knowledge of his day to organize the improvement of a technical process. He may have borrowed his ideas for the use of sulphuric acid in bleaching from Roebuck, but his advocacy of them was fruitful and his insistence on analytical experiments was original. In a typical experiment he adds acid by teaspoonfuls to solid alkaline ash "to

determine the quantity and strength of the salt they contained". He pioneered in testing the hardness of water, making use of what appears to be the earliest described precipitimetric titration (carbonate solution added to hard water: end point shown by cessation of precipitation). Home's analytical work dropped out of sight, as did that of William Lewis who titrated soluble alkali in American potash with hydrochloric acid, using litmus paper as indicator; the determination of quantities was still gravimetric.

From about 1784, titrimetric methods began to be used in theoretical investigations as well as in technical testing, with de Morveau describing an early graduated vessel for use with solutions and estimating carbon dioxide in solution by titrating with lime water.

The analysis of mineral waters excited a good deal of interest but no one analytical method took first place, acid and alkali determinations developed in other connections being used where appropriate. It was Berthollet's chlorine-bleaching as much as anything which led to the establishment of the solution-volume system, since this was the only system of test easily applicable. In 1789 Berthollet describes the bleaching of a solution of indigo in sulphuric acid by the bleach solution (chlorine water) under test. A graduated cylinder is used as reaction vessel, and the determination is therefore made volumetrically. Berthollet ascribes the method without reservation to Descroizilles, whose own later papers call his process "berthollimetry". Eventually in 1806 Descroizilles combined in one system the essentials of the reductometric and alkalimetric methods, describing a burette from which reagent could be delivered drop by drop by stopping with the thumb an air hole adjacent to the delivery hole (as distinct from the pipette in which the stop hole is just one extremity of a straight tube).

Rancke Madsen ends his account just at the point when analytical chemistry was ready to receive the thrust of Dalton's powerful correlation of analytical data. He does not enter deeply into the relation between analytical methods and theories of constitution. For a great deal of analytical practice such considerations would not have seemed relevant. In the 18th century, as now, the chemist who was called upon to carry out frequent analyses was very often a technical man, (either employee or consultant), to a high degree empirical in his approach, adapting the theory of his day where it was useful. Berthollet is perhaps an exception to this rule, but even his theories of chemical constitution were in tune with his experience of handling numerous examples of the materials of the technical chemist. When he comes to sum up the theoretical background of 18th century analysis Rancke Madsen goes further than some would follow him.

"Prior to the formulation of an actual atomic theory the thought behind the titrimetric principle, which is the same as the thought behind the principle of equivalence, has presumably had no possibility of a theoretical basis, but still the thought was alive long before Dalton. The subconscious thought that the same quantity of matter is always required to react with a given quantity of matter B, and that there must be proportionality among different sets of ratios of A and B, is in itself so natural, that no formulation or justification is needed at all to create it. But the thought is natural also to the more reflective chemist of the 18th century, at any rate, where the question is always of getting the matter A from the same kind of product; he seems less certain if the matter A originates from different sources".

It has to be recalled that Bergman was careful to speak even of his wet analyses as assays. So far from its being a subconscious thought, the constancy of proportion of A and B was to be a matter of open dispute. It took the atomic theory to remove analysis from the logical confines of assaying.

It is true of the whole history of chemistry and particularly true of analytical chemistry, that one must take care to discover what was generally known and applied at any time as well as what was apparent to a single observer. A chronology of ideas conceived does not make a history of ideas in growth. Rancke Madsen has kept this in mind and he is careful to state what methods were practised and for how long. A most valuable feature of the work is the series of Rancke Madsen's own experimental studies of the 18th century analytical methods. Obscure passages in the texts, and the probable composition of materials used, have been elucidated in the laboratory. This experimental study of history deserves every encouragement.

The translator's English is occasionally imperfect, and there are rather many errors of proof-reading, but the general impression is of a confident and lucid style. It is only to be regretted that this excellent publication has neither name nor subject index. F. G.

Dante Alchimiste. Interprétation alchimique de la Divine Comédie. Volume I, l'Enfer. By JACQUES BREYER. Pp. 267. Paris, 1957. Éditions du Vieux Colombier.

ANOTHER book on alchemy. This time the alchemical mantle has fallen on Dante. Who will be next?

Even so, this book is interesting and worth reading from several points of view. There is an opening chapter in which we have quotations from contemporary French works on alchemy and here, incidentally, we are told that that gifted writer, René Alleau is both an adept and an initiate. On p. IX there is a passage—a quotation from Monsieur Alleau (taken out of context) referring to the Beya myth as an example of "jargon alchimique". Professor Jung has explained in detail what the alchemists meant by Beya and why this story was used by alchemical authors to explain an important stage in what the writers of his school call the psychological change in the attitude of the alchemist. However, one must be fair-minded: this chapter is written by a friend of the author of the book under review, and as an example of literary back-slapping it is most diverting.

The next chapter, "Panorama sur le Grand Oeuvre", is the best chapter in the book, so it seems to us. Monsieur Breyer appears here as a scholar of profound intuition; his point of view is that of the "esotericist", and his description of the alchemical process and the reaction of the alchemist himself to the changes he is supposed to effect on the material substance with which he is experimenting, is unusual and very revealing. For those who believe that the "manufacture of the Stone" is a path of approach to an extended consciousness, this chapter, written without the usual suggestive hints and mystery-mongering, will teach them much.

In the remainder of the book Monsieur Breyer applies his great knowledge of the subject in trying to show that Dante's epic can be interpreted as an alchemical poem, in which all the stages of the alchemical transformation are minutely

revealed by a master. Dante's text is given chapter by chapter, followed by detailed notes of the author. These notes are well worth reading, they contain many fruits of the author's intense preoccupation with the subject and give the English reader another, and this time a very genuine approach to alchemy such as is only found among French writers. But to try and prove his thesis, that Dante is an "alchemist"—and further volumes will shortly appear—this, the author has not done in his book. The alchemical process on its psychological side, if we accept this phase of alchemy, can, of course, be likened to the spiral-path of religious fulfilment. But this is not exactly what is meant by alchemy. The great French writer, known as "Argos", comes nearer the mark when he says that Dante is the greatest esoteric teacher that Christian civilization has produced. G. H.

Le Mystère des Cathédrales et l'Interprétation Ésoterique des Symboles Hermétiques du Grand-Oeuvre. By FULCANELLI. Preface by Eugène Canseliet; 39 Plates after the designs of Julien Champagne. New and augmented edition. Paris, 1957, Les Éditions des Champs-Élysées.

IN this interesting book there is an extraordinary range of reference to works and concepts that lie within the literature of what is called "Hermétisme" in France. The author is one of those few who have a positive knowledge of the meaning of European alchemy; he unites a remarkable intuition with brilliant combinations of ideas that give his work a distinct flavour.

The author believes that the architectural forms of the Gothic cathedrals and their sculptural manifestations are the media through which the different stages of the alchemical process are symbolically described. A symbol has many levels of interpretation, and it is a fact that the language of the alchemical texts is largely symbolical. However, as the origins of alchemy are not found in Christian countries, any attempt to use Christian symbolism as the key to the understanding of the alchemical process presupposes the identity of Christian and Hermetic symbolism. This is to some extent true: all symbols relating to the perfection of man are "archetypal" in essence, and European alchemy has added to the old alchemical vocabulary a new thesaurus of words and phrases which would not have been understood by the Arabs and the Greeks. That this new Christian vocabulary of symbolic forms can be applied to mediaeval architecture and sculpture, is, and has been the contention of a traditional school of alchemical writers, and we shall leave it at that. Fulcanelli comes nearer the mark when he speaks of the "cabale phonétique". He analyses the symbolical value of words in terms of their vowels; he dissects words, and consciously bases his conclusions on linguistic and phonetic laws different from those used by the specialists of today. This "exegesis of vowels", as it is called, is found in the works of some Arabic writers on alchemy, Jabir, for instance, and Ibn Khaldûn; a knowledge of this exegesis is essential, according to these authors, for a correct interpretation of the texts. These authors go so far as to maintain that here you have the cipher that contains the key to the "alchemical mystery", and that the origin of this cipher is found in remote antiquity.

With great intuition, Fulcanelli has combined this "exegesis" with an attempt to explain why so many mediaeval forms, especially the architectural and sculptural representations are, according to him, symbolical signposts along the

path of alchemical perfection. Fulcanelli is one of the few modern authors who has a precise knowledge of the alchemical process—his very guarded explanation of his "cabale phonétique" shows this—but it is true that he undoubtedly gives an exaggerated "Hermetic" significance to many of the sculptures which he describes. Perhaps he does this because this is his method of imparting his knowledge to his readers, and his wide familiarity with the subject is thus given its proper place. It is here that the book transcends the "symbolical" interest the reader may have in its message and becomes a guide for the student, and a teacher who always emphasises the positive value of the whole system of alchemical ideas. Fulcanelli is at his best when he explains seemingly obscure passages, always basing his inferences on the "numinous" quality of the word. Here he accepts to a certain extent the parapsychological basis of alchemy; to a greater degree, perhaps, than do Professor Jung and other Continental scholars with whom this particular problem of parapsychology in recent years has become very important.

Fulcanelli describes for us the doctrine and the technique of a gnosis intimately related to a pursuit of illumination, a kind of Yoga of the Occident which has as its object the liberation of light imprisoned in matter. The transmutation of matter leads to a transmutation of spirit: an edifice of light is built upon an edifice of matter after the latter has been redeemd from its grossness—a grandiose conception which the author has set forth in a masterly fashion.

Mention must be made of the beautiful and tasteful production of this book, a credit to the enterprising Publisher. G. H.

Das Geheimniss der Adepten. By Alexander von Bernus. Pp. 67, with an appendix including articles by Gambriel, Erich Sopp and others. Osiris Verlag: Sersheim, Württemberg, 1956.

The author of this book is well-known in his own country as a Spagyrist and one who has tried—and with some success—to unravel the alchemical mystery from a purely experimental point of view. This sound approach to alchemy, based on his own interpretation of the texts, the absence of any attempt to look upon the alchemical experiment as a "mythology that must be experienced" and the endeavour to find a common centre in alchemy in much more simple terms than can be found in most modern writers on alchemy give this book an especial value.

Mention is made of two books, probably not so well known to the English reader: Weidenfeld's *De Secretis Adeptorum Sive De Usu Spiritus Vini Lulliani*, (2nd edition, Hamburg 1685) and *Des Hermes Trismegistus Wahrer Alter Naturweg*, (Leipzig 1782) which are used to illustrate the author's thesis, which is this: the mainspring of the whole alchemical process is what the texts call the "Secret Fire of the Adepts". Now we must admit that von Bernus, who has devoted his whole life to the study of the alchemical books and must be taken seriously for this fact alone, even if he be mistaken, which we are not in a position to judge, here agrees with some of the best authorities. Lull, for example, Trevisanus, Ripley and others. The modern student will want to know what this "secret fire" purports to be and this question can only at present be answered in a limited sense. Again we must use Jung's phrase, which is applicable here, that alchemical concepts are to be taken in a "numinous" sense; when Weidenfeld uses the word "fire" he means also a certain solar

emanation which modern physicists are beginning to take seriously from an angle that is no longer based on the ordinary rational experiment of the past. We are dealing here with forces for which new formulae will be found. The importance of alchemy is that these "new" forces have for many centuries been known, at least in the speculative sense.

Von Bernus has rendered a service in bringing the alchemical problem to a single formula and thereby simplifying the issue and giving the student a sense of direction which he cannot find in other modern works, where there is bound to be well-meant confusion and often a lack of a correct understanding of the texts. At the end of this book there is an interesting article by Erich Sopp on Hermetic symbolism, written with considerable insight and intuition. G. H.

History of the British Iron and Steel Industry from *c.* 450 B.C. to A.D. 1775. By H. R. SCHUBERT. Pp. xxi + 445. Foreword by the President of the Iron and Steel Institute. Frontispiece in colour, 36 Figs., XI Maps, 26 Plates, 18 Appendices. London: Routledge & Kegan Paul, 1957. Price 60s. net.

To the preparation of this altogether laudable and eagerly awaited work, Dr. Schubert has brought the skills of an archivist, the experience and attributes of a scholar, a unique knowledge of the history of iron and steel production throughout Europe and the fruits of more than twenty years of research on his subject. The result is a masterly and absorbing account of the early methods of extraction and production used in the British iron and steel industry—not an industrial history in the economic or commercial sense—and it will doubtless remain the most complete work on the subject for many years.

The story is told in two parts corresponding to two fairly clearly defined periods; in the first, covering almost two thousand years up to about 1500, iron was extracted in small bloomeries; in the second, it was obtained indirectly, the two stages being the production of cast or pig iron with the help of an air-blast and the conversion of pig iron into malleable iron in forges. The period of the book ends at 1775, a date that represents not so much the end of the charcoal-iron era in Britain as the beginning of a new age of iron linked to power, ushered in by Watt's steam-engine, which then became commercially available. Dr. Schubert relates his findings with sympathy and with a deep understanding of the problems ironmasters in this country had to face; he makes no unjust comparisons between their performance and the better results obtained by others on the Continent and in Sweden, who often operated on much richer ores. He maintains that "the history of iron and steel in Britain is largely a history of the ironmakers' skill. . . . It is a story of invincible perseverance which never shrank from unfavourable conditions nor was defeated by initial failure. Their difficulties were not made easier by their having to meet fierce competition from other producing countries, particularly Sweden."

Never has this history been told with such detail nor the records sifted with such thoroughness and to such good effect. These include published and manuscript material in the national collections, the work of local and county archaeological and historical societies, manuscript records in public libraries throughout the country, the archives of families and the collections of individuals. Two examples of the author's thoroughness may be mentioned. A great deal has

been written during the past century of the part played by Major John Hanbury in developments in Monmouthshire, much of it on very slender factual foundations. A few years ago Dr. Schubert published a short account of a manuscript he had traced, in which John Hanbury gave a fairly complete account of his activities at Pontypool and Llanelly in 1704, with additions up to 1708. This is now reproduced as an Appendix, and it is described as a manuscript in the Pontypool Public Library. As a second example one may refer to the collections on iron made by the Surrey chemist William Lewis in the last years of the period with which the book deals. On the publication of his *Philosophical Commerce of Arts*, Lewis was taken to task by a reviewer for having written on somewhat recondite subjects, and as a topic for his next volume (which was never completed) iron was suggested, as something of far more general interest and importance to the country than platinum, on which Lewis was a leading authority. Dr. Schubert mentions that these collections, which ran to six volumes, are in the Cardiff Central Library, and anything in them that could throw new light on the subject of the book has been used.

The work is handsomely produced and lavishly illustrated, and one's only regret is that some of the most interesting pictures reproduced in it originated on the Continent or in Scandinavia. The difficulty of illustrating such books with native material is indeed well known. With an expression of our gratitude to the author should be coupled one of appreciation to the Iron and Steel Institute for the part they played in helping him to realize his ambition, and to the publishers for having provided a book that is a worthy addition to any library.

F. W. G.

Lavoisier et la Révolution Française. I. Le Lycée des Arts. Édition revue et corrigée. By LUCIEN SCHELER. Paris: Hermann, 1957. Pp. 77. Price 480 fr.

DURING the Revolution there sprang up in France several societies concerned with the applications of science; the most important was the Lycée des Arts. M. Lucien Scheler has thrown new light on its origins in 1792, and has reprinted the contributions of Lavoisier, its second president, to the first series of the *Journal du Lycée des Arts* (1793). He is to be congratulated on locating all the issues of this very rare journal, which was overlooked by the compilers of the *Oeuvres de Lavoisier*.

Students of Lavoisier can now read his important account of the development of the metric system, his reports on Berthollet's bleaching process and on the work of the Academy of Sciences in April and May, 1793, and his opinions on the need for technical education. Also reprinted is the *éloge* of Lavoisier by E. J. Bouillon-Lagrange, which was unknown to all Lavoisier's biographers.

Lavoisier's activities during the Revolution have received insufficient attention from historians, and we hope that the further studies promised by M. Scheler will not be long delayed.

W. A. S.

PUBLICATIONS RECEIVED

Revue d'Histoire des Sciences et de leurs Applications. Tome X, Nos. 3 & 4, July-September & October-December 1957. Paris: Presses Universitaires de France. (Annual Subscription to Great Britain and the Commonwealth, 27s.)

No. 3 has main articles on: Enseignement scientifique et Histoire des Sciences, by Charles Brunold; L'Argent dans la Littérature ancienne de Mésopotamie, by Martin Levey; Remarques sur les formes et les limites de la pensée technique chez les Grecs, by Jean-Pierre Vernant; Les idées de Roberval sur le système du monde, by Léon Auger; Roberval "éditeur" de Mersenne et du P. Niceron, by Robert Lenoble. The section on 'Documentation et Informations' contains contributions by Pierre Speziali on Augustin Fresnel et les savants genevois, and by Karel Rychlík on Un manuscrit de Cauchy aux Archives de l'Académie tchécoslovaque des Sciences; obituaries of Henry Sigerist and René Dugas; notes on conferences and anniversaries. A section headed 'Analyses d'Ouvrages' completes the issue.

Tome X, No. 4, contains articles on: Tableau chronologique de la vie et des œuvres de Fontenelle avec les principaux synchronismes littéraires, philosophiques et scientifiques, by Suzanne Delorme—who also writes on: Contribution à la bibliographie de Fontenelle, and La *Géométrie de l'infini* et ses commentateurs, de Jean Bernoulli à M. de Cury; Retouches au portrait de Fontenelle.—Pièces inédites, by Geneviève Martin; Fontenelle et la Société Royale de Londres, by Professor Douglas McKie; Fontenelle et la géologie, by Arthur Birembaut.

The section headed 'Analyse d'Ouvrage' is followed by a general index to this volume.

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